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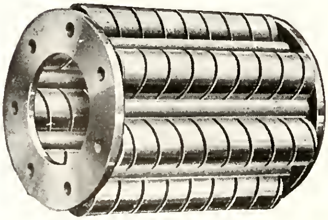

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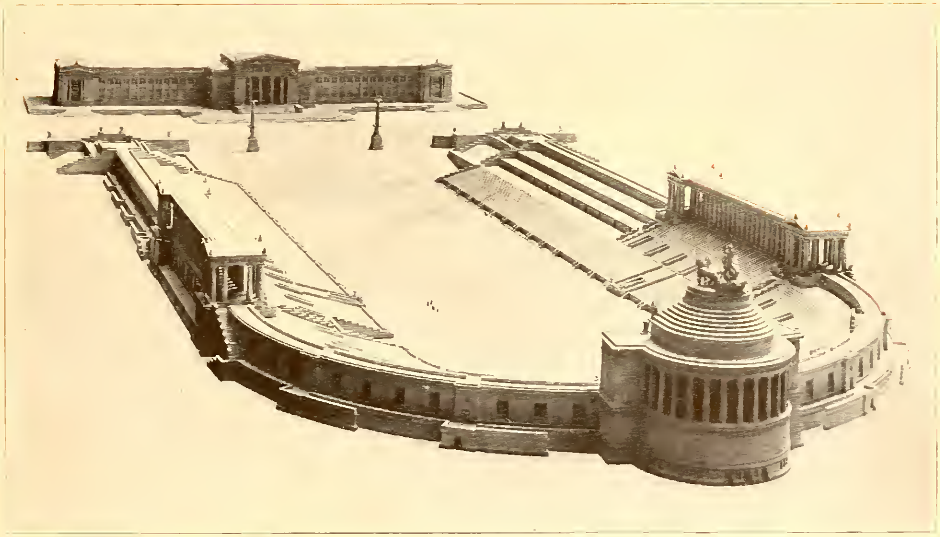

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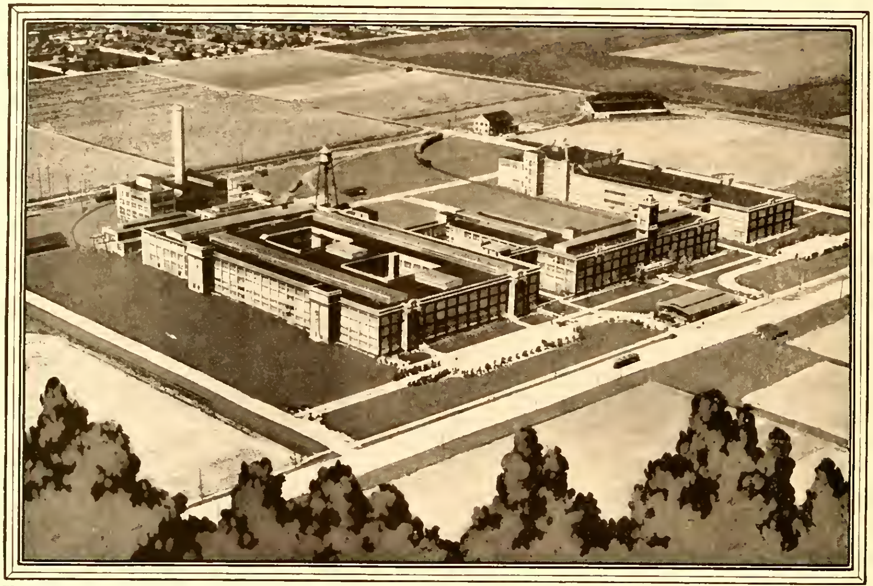

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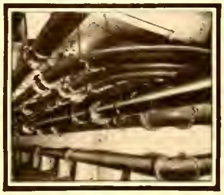

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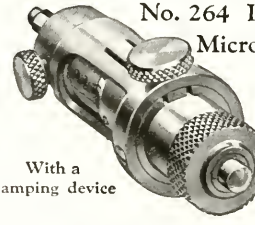

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THE DISADVANTAGE OF POOR LIGHTING.

As thousands of our industrial plants are operating to-day with poor lighting and in some cases with extremely bad facilities, it would seem that the importance ot the subject of lighting has not been given the serious consideration by those responsible for such conditions.

Poor lighting is one of the most serious handicaps under which a manufacturing establishment can operate. First of all, poor lighting is the cause of a large number of accidents in industrial plants; and it is singular that accident reports do not yet properly classify the hazards of poor lighting, which in many cases is the primary cause of an accident attributed to what is really a secondary cause. Safety engineers and other officials who make accident reports should always consider the condition of the lighting when working up a report of accident causes, for it plays an important part in a great many casualties and is apt to be overlooked. All accidents due to poor lighting are accidents of neglect, and are preventable. The poor lighting accident hazard is clearly chargeable to management and not men. It is a difficult matter to make such progress with Safety First in a plant which has neglected to provide one of the fundamental requirements of accident prevention—good lighting.

Probably no one single factor connected with the equipment of a plant so directly affects the efficiency and inefficiency as the quality and quantity of the lighting. The curtailment of production of all working under the disadvantage of poor lighting represents a big loss each day; the poorer the lighting the less able is the working force to function efficiently. Quality and quantity both suffer, representing a preventable loss wholly removable by improving the lighting.

Under poor lighting condition, we cannot expect and rarely do we find an orderly, clean factory. Darkened places encourage careless habits and workers are often led to deposit discarded articles or material which should be deposited elsewhere. The eyesight of those who attempt to use their eyes continually in insufficient light, below nature's demands, is often affected. Too much light, such as is furnished by bright, unprotected lights, is as harmful as too little illumination; both are fundamentally wrong. Nature's own illuminant, daylight, is unequalled for our requirements of lighting.

The eye is best suited to daylight in the proper quantity. Sun glare should be avoided, and in the darkened hours proper artificial illumination provided. Daylight should be utilized to the fullest extent. It is supplied free in abundant quantity for our use. Modern invention has supplied a means whereby the interior of buildings can be lighted by daylight, and all the advantages secured which is furnished by good lighting at the smallest cost.

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The Armour Engineer

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VOLUME XVI NOVEMBER, 1924 NUMBER 1

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SUMMER CAMP

By

R. L. LAWSON, '25

ALL aboard! The words thus spoken were the starting signal for Armour Tech's most adventurous and delightful course—Summer Camp. Our adventures began immediately upon leaving Chicago. Few of us will forget the argument between Cailles and the porter. Lucky for the porter that they were soon separated!

Our arrival at New Lisbon, where we changed cars, had evidently been well heralded since the three town belles were waiting on the platform to give us a hearty welcome. It was unfortunate that Pete became so interested in these country maids, since this led to a sprained ankle when he missed a step while conning the heavens with them.

At Minocqua it was necessary to transfer to Charlie's Race Horse, the only train in the state with an advertised speed of 13.2 m.p.hr. Even this amazing speed proved to be too much for the Grass Line Special, as there were two wrecks during our stay at camp.

The station master told us gravely that the Trout Lake train would be late in starting that morning, "perhaps, ten or fifteen minutes late" due to some unknown cause. We afterward found that the delay was caused by the frequent necessary stops to trim the grass in order that Charlie's train could find the rails.

At 12:30 p. m. we arrived at the State House Station where we were met by Professors Wells and Stevens, and their assistant. They had preceded us by four days and had pitched the tents and made camp.

Our immediate interest upon arrival at camp centered in the culinary department, presided over by three capable cooks (needless to say—of the fair sex). The camp kitchen continued to be the center of our gastronomic and social interest throughout our stay at camp.

We wonder what made Lawson so happy after he looked through the telescope.

The first few days directly after our arrival were spent in setting our tents in order. Our preparations included a thorough defense against the vicious attacks of the mosquitos, in the form of mosquito nets. These, however, proved to be mere resting places for the insects after they had satiated their appetites upon us.

With the camp in order, our interest shifted to the surrounding environs, which we proceeded to explore, especially the reputed Indian battlegrounds.

Field courses permit the student to acquire much practical information by direct experience. Among the things we found out—after a few nights—was the necessary amount of blankets to permit a heat balance to be maintained between radiation and internal combustion.

Aside from our daily required stints, our avocations took two forms, letter-writing and fishing. The first successful fisherman was Paul Graf, but the best fish story is accredited to Gabbert. After he had lost his tackle and ten foot pole to a muskie which made a hearty meal out of them (so the story goes) he caught three five pounders with an ordinary string and hook.

The faculty, apparently, could not do without us. On June 8 we were the hosts of Professors Wilcox, Palmer, Libby, Roesch, Krathwohl, Moreton, Kennedy, and Professor and Mrs. Philips. During their brief stay Professors Libby and Wilcox tried to wrest the horseshoe championship from Johnson and Peacock, but were not successful. Because of the interest shown in horseshoes, the professors later sent us a set of standard shoes which were quickly put to good use.

On July 6, we were glad to greet Professor Tibbals and his family at our camp. Marhoefer and Lowe of A. I. T. were our guests on June 10. They put up with the Saints and left the next day, as they were on a camping trip.

Outside of working hours, the time was spent in rowing, fishing, swimming, hiking, playing horseshoes, and baseball. In baseball we were very successful, due to the pitching of Harrower and Samuels, and the good support of the players and fans. The past "generations" should be proud of the splendid showing made by the camp team in defending and indisputably retaining the baseball championship of Trout Lake. The team, led by Captain

(Continued on page 32)

HELIUM

AN ACCOUNT OF ITS DISCOVERY AND PROPERTIES

By

THOS. E. DOUBT, *Ph.D.*

Associate Professor of Physics

Professor T. E. Doubt.

THE appearance of the great helium-filled airship Shenandoah over Chicago last autumn gave a thrill to all beholders, especially to those who realized its size, power, and the magnitude of the achievement which it represented.[1] The discovery of helium and the growth of our knowledge concerning it are good examples of the way in which physical science develops. The history of scientific ideas should be of interest to everyone who is concerned with the solution of new problems either in engineering or in research for its own sake.

On August 18, 1868 there was an eclipse of the sun visible in India. The newly discovered spectroscope was just coming into use and was directed toward the prominences which were visible when the sun was hidden by the moon. In the spectrum of these flames shooting high above the surface of the sun, the French astronomer, P. J. C. Janssen, noticed an especially prominent bright yellow line. Other prominent lines could be observed which could be readily identified with well-known elements on the earth. Hydrogen gave a bright red line, another in the blue and a third in the violet. The prominent yellow line was first thought to be due to sodium because it was near the Fraunhofer lines D_1 and D_2 which are caused by sodium. The next day Janssen observed the prominences and was able to show that this bright line was not coincident with the sodium lines. Lockyer and Frankland called the line D_3 and since it did not coincide with a line of any known terrestrial element they ascribed it to a hypothetical element which they called helium from the Greek word *helios*, the sun. Over twenty years elapsed before it was found on earth. In the meantime astronomers had found it in many nebulae and bright stars even in very remote parts of the universe.

In 1889 Dr. Hildebrand of the U. S. Geological Survey reported in *The American Journal of Science* that he had obtained a peculiar gas from the mineral uranite. Sir William Ramsay repeated this experiment, confirmed the presence of a new gas, and with the aid of Sir William Crooks he was able to prove that the gas gave the light of the yellow line which coincided with D_3. Ramsay found the gas in many other minerals, in spring waters, and in natural gas. Since 120 tons of liquid air had been placed at his disposal, he was able by fractionating it to discover two other elements belonging to the argon-helium group, namely, neon and krypton. And from the uncondensed portion of the air used in producing the liquid air he was able to demonstrate the presence of helium in the atmosphere.

Helium, like other members of this group, has no chemical affinity for any substance and it may be said to have zero valence. Not only can it not be made to combine with any element, but it has the lowest solubility in water of any gas. Professor Julius Thomsen, renowned for his work in thermochemistry, published a number of papers on the periodic table of the elements. In one of these published before the discovery of argon he discussed the necessity for a series of transition elements with no chemical affinity and zero valence to be placed between the highly electropositive and the highly electronegative elements. According to his prediction the missing elements would have the properties of the helium-argon series and would be placed between the group fluorine, chlorine, bromine, iodine, and the group lithium, sodium, potassium; that is, between the halogens and the alkalis.

The physical properties of helium are as remarkable as are its chemical properties as indicated by its position in the periodic table. It comes close to being an ideal gas in that it obeys the laws of Boyle and Charles more closely than any other gas. Hydrogen and nitrogen are the only elementary gases that even approach the role of perfect gases. Nitrogen becomes a liquid at −194° C and hydrogen at 252° C, but helium does not liquefy until a temperature of −268° C is reached. In the temperature range 0 to 500° C its expansion coefficient is so nearly constant that the temperature scale obtained by its use in a gas thermometer agrees almost perfectly with the thermodynamic scale of temperature. The density of liquid helium is less than any other liquid: hydrogen as a liquid at its boiling point has a density of 0.15 grams per cubic centimeter, while helium weighs only 0.12 grams per cubic centimeter. Metals at the boiling point of helium become super-conductors of electricity. In some cases the resistance is less than one ten-millionth of what it is at ordinary temperatures. Hence it may be used as a refrigerant and opens up a vast region for the investigation of the properties of bodies at very low temperatures. Helium is a better conductor of heat or electricity than either hydrogen or air. The refractive index and the dielectric constant of helium are smaller than those of hydrogen or air, in fact, a vacuum is the only space in which these quantities are smaller.

Another major research directed by Ramsay resulted in the discovery that helium is one of the products of the decomposition of radium and thus gave the first direct evidence for the transformation of the elements. Soddy, Rutherford, the Curies, and many others have shown that helium is one of the products of radioactivity. All radioactive elements which produce alpha rays give off helium. Alpha rays are streams of positively charged particles. When one of these particles takes two electrons it becomes a neutral helium atom. On account of the high speed with which the alpha particles are expelled from radium these have great penetrating power. Rutherford has used the tremendous energy of the alpha particles in bombarding gases. In this way he has been able to show

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MODERN SEWAGE TREATMENT
in
THE SANITARY DISTRICT OF CHICAGO

By

F. W. MOHLMAN, *Chief Chemist*

THE average person has little conception of what is meant by sewage treatment, and still less knowledge of what the technical processes of treatment may be. He may have heard of septic tanks, sand filters, or stone filters, but these processes call to his mind nothing more than an area of concrete tanks, or a stretch of porous sand or stone miraculously prepared by nature for the purification of sewage. He would be surprised to learn that sewage treatment processes are based on complicated bacterial reactions and that modern treatment works contain many mechanical devices such as air compressors, patented settling tanks, filter presses and rotary-kiln dryers. He would be interested to learn that the control of sewage treatment demands a knowledge of chemistry, bacteriology, and engineering; and that improvements in existing processes are due to painstaking research, started on a small scale and developed to the design of plants treating many millions of gallons of sewage per day.

The Sanitary District of Chicago is now operating two large-size treatment plants and is building the largest treatment plant in the world, to operate by the activated sludge process. A description of these plants will indicate the nature of the construction of a modern sewage-disposal plant. The control of their operation is based on the collection of accurate engineering and chemical data.

Treatment Works

The two large treatment works now operating are the Des Plaines Works, in operation since August, 1922, and the Calumet Works, in operation since October, 1922. The location of these plants is shown in Figure 1. The Des Plaines Plant is entirely an activated sludge plant, and the Calumet Plant primarily an Imhoff tank plant, although it includes three-quarters of an acre of sprinkling filters and two complete activated sludge units. The large North Side Plant is now being built. It will be an activated sludge plant, capable of treating 175,000,000 gallons per 24 hours.

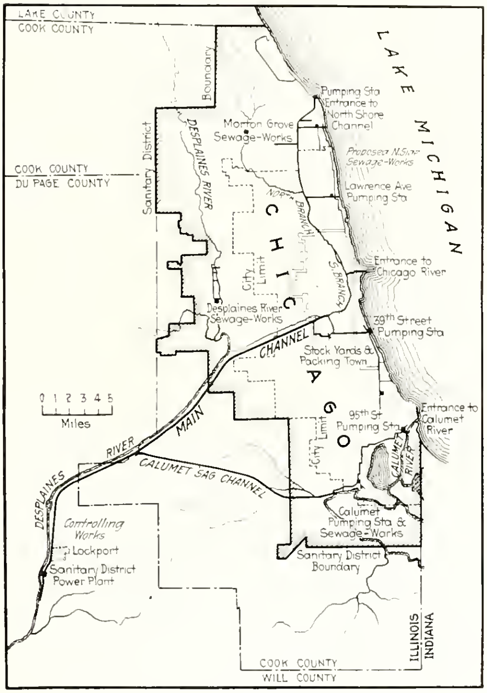


Figure 1. Map of the Sanitary District of Chicago.

There are only two standard complete processes suitable for treating the sewage of Chicago, and these two are (1) Imhoff tanks and sprinkling filters and (2) activated sludge. The choice between these processes is dependent on their relative cost, quality of effluent obtainable, freedom from nuisance and odors, and dependability. A brief description of each process may be necessary in order to indicate the theory and mechanism of their operation.

Imhoff Tanks

The Imhoff tanks at the Calumet Plant are typical of modern design. An Imhoff tank is merely a settling tank, with a false bottom which is trapped in such a way that the solids slide down into a lower compartment, in which they are permitted to remain until completely "digested", that is, until ebullition of gas ceases almost completely. The solids are completely changed in nature by this digestion and are removed as a black, porous sludge, which has little odor and which dries readily on drained sand-beds. The lower compartments are designed large enough to hold the accumulation of sludge throughout the winter, when it is impossible to dry it on sand-beds, as it freezes and does not part with its moisture. The capacity of the lower sludge compartment is usually designed for from 1 to 3 cubic feet per capita.

The upper or "flowing-through" compartment is usually designed to give a detention period of from 2 to 3 hours. If the tanks are operating properly there will be no disturbance by gas and sludge masses at the surface and no scum such as is usually found on septic tanks. The tanks accomplish nothing more than a partial removal of the insoluble solids, a purely physical phenomenon, with accompanying biological decomposition of the deposited solids. The sludge is much easier to dry and is much less offensive than the freshly-deposited solids. A cross-section of the Calumet tanks is shown in Figure 2.

Sprinkling Filters

Sprinkling filters are of simple construction but accomplish remarkable results in the treatment of sewage. They consist of beds, from 6 to 8 feet in depth, of crushed stone (from 2 to 3 inches in diameter), over which the settled sewage is sprinkled through sprinkler heads spaced approximately 14 feet, center to center. The surfaces of the stone become coated with a slimy, gelatinous coating which is teeming with bacteria and higher organisms. These bacteria work over the organic matter aerobically and transform unstable protein-like material into stable oxidized and nitrified compounds. The sewage filters through the interstices in thin films which are exposed to the action of the bacteria, so that the reactions take place very quickly. The sprayed liquid carries enough oxygen into the bed to promote the growth of nitrifying bacteria. The openings in the bed are so large, however, that very little removal of suspended solids occurs, with the result that the effluent contains almost as much insoluble matter as the influent, but in a much more stable form. This suspended matter must be settled out in a secondary settling tank. Part of the suspended solids are retained in the filter, however, and were it not for an interesting biological action called "unloading" the filters would soon clog and become impervious. Each spring, however, the films begin to slough off the stones, and during April and May the effluent usually contains much more suspended matter than the influent. After the unloading has ceased, the filter is open and clean, and ready for another year's work.

The changes accomplished in a sprinkling filter or "bacterial bed" are much more profound than those which occur in Imhoff tanks. If we measure the strength of sewage by the amount of oxygen required to oxidize the organic matter, it will be found that Imhoff tanks may be able to reduce the oxygen demand of the sewage about 40 per cent, while sprinkling filters can reduce the oxygen demand 100 per cent when operating efficiently.

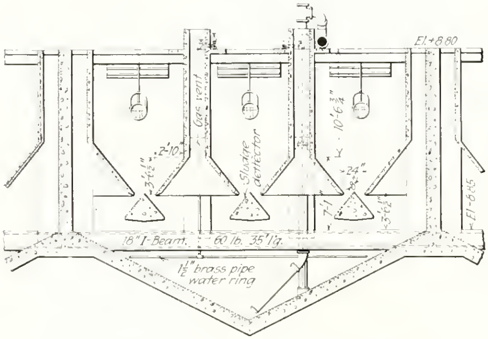
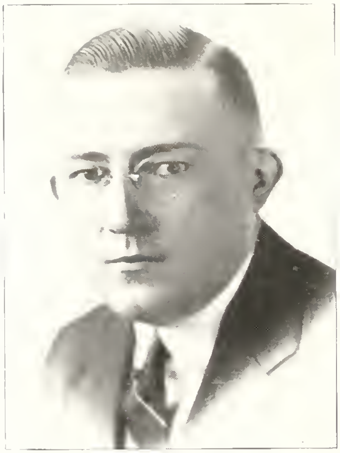


Figure 2. Cross section of the Calumet Works Imhoff Tanks.

Large areas are required for sprinkling filters since only two to three million gallons of settled sewage can be treated per acre of beds. They have a number of disadvantages such as odors, the production of small flies (psychoda), and very heavy initial expense. On the other hand, however, they produce a very satisfactory effluent, are rugged and relatively foolproof, and are very economical in operation.



Mr. F. W. Mohlman.

The combination of Imhoff tanks and sprinkling filters is quite feasible for treatment of Chicago sewage, and until 1914 these processes were considered the best available. In that year the activated sludge process was developed, and it is now being used in preference to tanks and filters for most of the Chicago treatment works.

Activated Sludge

The activated sludge process is a complete process in itself, requiring only a preliminary removal of coarser solids by screening. In this process finely-diffused air is blown through the sewage as it passes through concrete tanks. The bottoms of the tanks are partly covered by porous diffuser plates, through which the air bubbles. The depth of sewage may be from 10 to 20 feet and the detention period in the tanks from 4 to 6 hours. The suspended and colloidal solids in the sewage are coagulated and formed into brown, sponge-like flocculi, which are accumulated in settling tanks and returned to fresh incoming sewage, while the clarified effluent flows over the outfall weir. The solid matter collected, called activated sludge, contains millions of aerobic bacteria which quickly accomplish the same purification effected by sprinkling filters.

Approximately twenty-five per cent of sludge by volume is maintained in the aeration tanks. When the sludge accumulates over this amount the excess is removed for disposal. The removed sludge, when dried, contains more nitrogen than any sludge from any other process of sewage treatment, and present indications are that it is worth from $20 to $30 per ton as a fertilizer.

The effluent from the activated sludge process is quite satisfactory. It is clearer and lower in bacterial content than a sprinkling filter effluent. The process is free from odors and flies, and can be installed on limited areas, as from 10 to 15 million gallons of sewage can be treated per acre per 24 hours. The cost of construction is less than the cost of construction of Imhoff tanks and sprinkling filters but the cost of operation is very great.

A plan view of our Des Plaines Treatment Works is shown in Figure 3. The aeration tanks are 10 ft. deep (one battery is 15 ft. deep), each followed by a battery of settling tanks. An operating gallery, in which are located valves, Venturi meters, orifice boxes, etc., separates the aeration and settling tanks. The sludge is settled in two types of settling tanks, one of which has a hopper-bottom shaped like an inverted pyramid, the other containing a dished bottom over which moving rakes pass, sweeping the sludge to a sump at the center of the tank. The hopper-bottom tanks must have 60° slopes in order that all sludge may slide to the bottom of the tank. This means that deep excavation is necessary for this type of tank. The other type, containing Dorr mechanism, is relatively shallow and also more satisfactory in other respects.

Sampling and Analyses

Completely-equipped laboratories are installed at both the Calumet and Des Plaines Plants. The operation of the plants is in charge of a sanitary engineer. The control of operation is based on chemical analyses, which furnish the yardstick by which the results accomplished may be measured. The first essential is accurate sampling.

The analysis of a single sample of sewage, selected at random, means nothing. Our daily samples are made up as a composite of 24 single samples, collected hourly. When the gallon composite sample is brought to the laboratory, a small sample (which must be unsterilized) is taken for determination of the biochemical oxygen demand, after which the sample is sterilized with chloroform before the other determinations are made. The determinations usually made on raw and settled sewage are ammonia nitrogen, organic nitrogen, biochemical oxygen demand, chlorine, suspended solids (total, volatile, and fixed), and occasionally oxygen consumed from potassium permanganate. The same tests are made on sprinkling filter and activated sludge effluents, and in addition nitrites and nitrates are determined as well as the stability to methylene blue. Total solids determinations are rarely made, and albuminoid ammonia, never.

Table I

CALUMET WORKS—Analytical Results

Summary, July, 1923 Through June, 1924

Results in Parts Per Million

	Nitrogen as				Dissolved Oxygen	Biochemical Oxygen Demand		Suspended Solids			Stability Days		
	Organic	Ammonia	Nitrites	Nitrates		2 day	5 day	Total	Volatile	Fixed	Max.	Min.	Average
Raw Sewage	5.9	4.3	...	...	1.15	38.3	64.3	74	40	34	..	..	..
Imhoff Effluent	1.3	4.7	...	...	2.33	22.3	34.7	31	19	15	..	..	..
Activated Sludge Settled	1.57	.18	.03	5.26	9.65	...	...	19	10	9	10	8	9.9
Activated Sludge Raw	1.79	.11	.11	3.95	9.13	...	...	27	15	12	10	8	9.8
Sprinkling Filter Final	1.48	.43	.18	4.77	9.33	...	...	26	12	14	10	8	9.8
Per Cent Reduction													
Imhoff	27	9 (Inc.)	...	...	...	42	16	54	52	56	..	..	..
Activated Sludge Settled	73	96	...	...	...	90+	90+	74	75	74	..	..	..
Activated Sludge Raw	70	97	...	...	...	90+	90+	63	63	63	..	..	..
Sprinkling Filter	75	90	...	...	...	90+	90+	65	70	59	..	..	..

Typical results for the Calumet Plant are given in Table I. These results indicate the relative work done by a clarification process and a complete process. The Imhoff tanks removed only 27 per cent of the organic nitrogen as compared with about 70 to 75 per cent removed by filters or activated sludge; only 42 to 46 per cent of the oxygen demand as compared with an indicated 90 per cent or greater reduction of oxygen demand; only 54 per cent of the suspended solids as compared with 65 to 75 per cent for the complete processes. Even

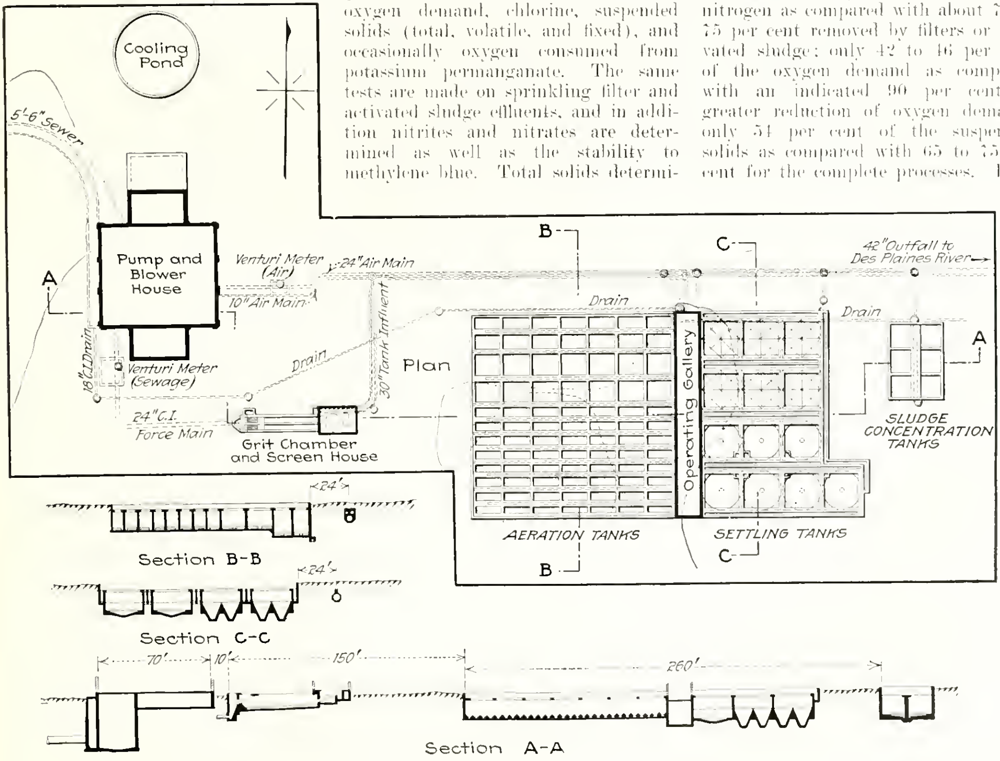


Figure 3. Plan of the Des Plaines River Treatment Works.

greater differences would be noted if the processes were dealing with a stronger sewage. The analysis of the raw sewage indicates that it is one of the weakest sewages on record. This is due to the excessive water consumption in Chicago.

It will be noted that a relatively large amount of nitrate nitrogen was found in the filter and activated sludge effluents. This nitrate nitrogen was formed by nitrifying bacteria from part of the organic and ammonia nitrogen in the raw sewage. Nitrates contain potential available oxygen ($5O$ in $2KNO_3$), which, with the increase in dissolved oxygen, is sufficient to stabilize the effluent completely, and in most cases to furnish a reserve supply of oxygen, so that the effluent may actually be able to improve the condition of a polluted stream.

Control of Operation

The activated sludge process requires considerable mechanical equipment such as pumps, blowers, and air lifts, which must be operated continuously. This continuous operation, especially of the blowers, is quite costly. The average power requirement per million gallons treated is about 40 horsepower, which costs $10.00 per million gallons per day with power at one cent per horsepower hour. By noting the concentration of nitrates and clarity of effluent, the volume of air required may be reduced safely, but if it is maintained at too low an amount, trouble will develop. The usual air requirement is from 1.0 to 1.5 cu. ft. per gallon, but we have been enabled to reduce this considerably by careful control. At one time we reduced the air supply at the Des Plaines Plant to 0.67 cu. ft. per gallon, but we soon began to have difficulty in filter-pressing the sludge and the nitrates almost disappeared in the effluent. The object of daily analyses is to enable us to use as little air as possible, but still not such a low amount that unsatisfactory results will be obtained.

We must watch the effluent to see that no sludge escapes. If the air lifts become plugged so that sludge is not constantly removed from the settling tanks it will flow out with the effluent. Our analyses indicate when this occurs.

The operation of the pressing and drying operations requires careful analytical control. Moisture, specific gravities, nitrogen contents, and hydrogen-ion content of the wet sludge must be known in order to accomplish successful filtration. The problem of filter-pressing the sludge from 98 per cent water content to a sludge cake containing 75 to 80 per cent water is a most difficult one, on which we have spent tens of thousands of dollars for experimental filters, presses, filter aids, and preparatory processes. The press-cake is then dried in rotary kilns to less than 10 per cent moisture content. This process must be checked by analyses of the moisture contents, composition of the coal used, calculation of the evaporation ratio, and complete fertilizer analysis of the dried product.

In the control of Imhoff tanks and sprinkling filters, it is not possible to vary conditions as readily as in the activated sludge process, but daily analyses are just as important. The sludge must not be permitted to accumulate until it fouls the sewage in the flowing-through compartment, indicated by an increase in suspended solids and septicity of the effluent. The sludge must be removed as fast as possible in the summer, and its volume and moisture content determined. By balancing the total weight of sludge removed against the total weight of solids settled out of the sewage (both on the dry basis) we can calculate the per cent digestion of organic solids that has taken place in the sludge compartment.

The sprinkling filter must not be permitted to pool or clog as it is a very costly operation to wash the stone if it has to be removed from the bed. The filter may pool if operated at too high a rate or if dosed with incompletely clarified sewage. Industrial wastes may inhibit effective operation. The nitrates must be watched, and if they disappear completely there is trouble ahead. The sludge in the secondary settling tanks must be removed at intervals and its moisture content determined.

With Imhoff tanks and sprinkling filters it is economically unprofitable to attempt to recover the sludge as fertilizer as it rarely contains over 3 per cent nitrogen on the dry basis as compared with 5 to 6 per cent in activated sludge. Accordingly, Imhoff sludge is spaded off the drying beds, loaded onto tip-carts and dumped on waste land adjacent to the plant. In some places it is taken away by farmers for local consumption as a fertilizer.

Special Problems

The activated sludge process has opened up more problems in sewage treatment than were ever conceived of by the operators of the simpler processes of past years. When the activated sludge process was in the first few years of its development it was hailed as the solution of all our treatment problems, mainly because of the high quality of its effluent and the possibility of recovering fertilizer values in the sludge produced. But as years have gone on it has been found that the process is very expensive and that it will take a long time and an enormous amount of experimentation to cut down the expense to an economical amount. Two main difficulties are now encountered—the large amount of air used and the trouble in pressing and drying operations. There is also a major problem in developing the use of the dried sludge as a fertilizer, but this is not so much a technical problem as one of publicity and education.

Volume of Air Required

The volume of air used for activation has been the subject of much investigation. The average amount has been 1.5 cu. ft. per gallon of sewage, while some industrial wastes have required from 3.0 to 4.0 cu. ft. per gallon. Tests made by Professor Bartow at the Illinois State Water Survey showed that a very small proportion of the oxygen in the air was used up in the aeration process. It is generally accepted that from 0.10 to 0.15 cu. ft. per gallon should be sufficient to meet the oxygen requirements of the sewage and sludge, or, roughly, 10 per cent is actually used biologically while the other 90 per cent is used for agitation and the thorough mixing required. It is essential that all sludge be kept in circulation and not allowed to settle on the bottom of the aeration tank where it would become anaerobic and would be detrimental to the efficiency of aeration.

All American installations have used Filtros plates for air distribution. These are artificial porous plates 1 foot square and 1¼ inches thick, which are cemented into containers connected with the air piping. At first, investigations were made concerning the area of plates required. It was found unnecessary to cover the entire floor with plates, and concrete spacers or ridge-blocks were placed between rows of plates so that only one-quarter to one-sixth the area of the tank bottom had to be covered by plates. With this "ridge-and-furrow" system it was undesirable to use fewer plates, and the air rate could not be reduced below the minimum necessary to keep the plates clean and the sludge in circulation.

The next development was to place rows of plates along one side of a flat-bottom tank, which might be 15 by 15 feet in cross-section. The air rises in a column on one side, inducing a uniform transverse circulation across the tank, down the opposite side, and back across the bottom of the tank. The velocity across the bottom must be more than one foot per second to keep the sludge from settling. We tried this type of tank in comparison

(Continued on page 29)

OLD CIVILIZATIONS AND OUR OWN

PART I

By
E. O. PIERCE, '24

Mr. E. O. Pierce.

WHAT is *civilization?* When is a man *civilized?*

We prefer, for the purposes of this paper, to define "civilization" with the International Encyclopedia as, "The condition of more advanced peoples in contradistinction to those classed as savage."

Let us examine this definition closely. The outstanding facts presented by it are that a difference exists, or is assumed to exist, between savagery and the "civilized" state; and finally that "peoples advance". It would seem from this definition and the conclusions drawn from it that were we able to show that the definition is correct and that peoples really do advance or progress, we might, by an examination of the causes and principles of this progress of society, accomplish the real purpose of our investigation.

But what is progress? Our dictionary defines it as "advancement". But in the case of society, advancement toward what? In answer to this, it becomes necessary for us to formulate our "first law of progress", a fundamental assumption upon which all that follows is built. It is based upon the fact that it is every man's aim to ameliorate his condition, to better himself—his desire to gratify his wants of a material nature, of an intellectual nature, and of a sympathetic nature; his desire to be, to know, to do. That thing is progress in a social sense, which produces this amelioration, this betterment, this broadening and lengthening of life, in the highest degree for the largest number of people. Defined in such necessarily highly general terms, and only from the standpoint of utility, we are inclined to object and to ask what things produce that which we have defined as progress. The answer is a cardinal purpose of this paper.

In searching for facts tending to prove or disprove the statement, "peoples advance", the first idea which comes to our mind is that of evolution. Does not the general acceptance of the theory of evolution imply an equally general acceptance of the idea of human progress, that "peoples advance"? Is not evolution a vehicle of human progress?

Fortunately biology comes to our aid in answering this question. And the answer is: In bodily (organic) evolution, man has made no very marked progress during the last *two hundred centuries* at least. There have been minor changes in the human body, both "progressive" and "retrogressive", as for example in an increasing resistance to certain diseases due to the elimination of the more susceptible; and in degenerative changes in sense organs, hair, teeth, etc., but very minor changes nevertheless. In fact, the physical evolution of man has slowed down almost to a standstill. And not only is this true of man's bodily evolution, but in contrast to the generally accepted opinion, it is true also of his mental evolution. Since the time of the Cro-Magnon race, about twenty thousand years ago, there has been no marked increase in man's cranial capacity and probably no increase in his inherent intellectual ability. (Conklin, "The Evolution of Man") Biologists tell us further that biological progress has its definite limits, and that man has in all probability approached very near to his natural limit as imposed by present conditions. If future biological progress is to take place, it must be along radically different lines, and in response to new and very different environmental conditions. Natural selection is the guiding force by which evolution works—by the elimination of unfit forms. But in modern human society, the operation of this force has almost been stopped. All but the most monstrous forms are permitted, nay, forced to live and allowed to propagate their kind.

The only conclusion obtainable from an examination of man's present state from a scientific point of view, is that organic evolution in man has long since reached a climax, some force having seemingly set aside the great evolutionary principle of natural selection. We can, therefore, expect no aid from this source in answering our current problems.

In the preceding paragraph, it was stated that "some force had seemingly set aside the great evolutionary principle of natural selection". What might this force be?

Man resembles animals "as they resemble one another—he differs from them as they differ from one another", says Huxley. If man is so similar to animals, it would seem that he must be subject to the same need of adjustment to life conditions. He should show differences comparable to those exhibited by animals as a result of adjustment to widely diverse life-conditions; and being the most widely ranging of all animals, he should exhibit the greatest physical diversities. But this he does not do. Human beings are much alike over time and space. Man is "unchanged in changing environment".

When a man goes into a cold climate, for example, some adaptation is necessary. In an animal this adaptation would take place in the growth of a thicker coat. Some small physical adjustment may occur in man, but the principal adjustment is an external one—brain-action results in the utilization of things available in nature as the instruments of adjustment. Every realization or materialization of brain adjustment constitutes part of the paraphernalia or apparatus of civilization—that which we call culture in its broadest sense.

This is the new form of evolution, which replaces and supersedes for man, organic evolution. And the outstanding characteristic of this type of evolution is that it is the product of numbers; it operates as a result of society, for the benefit of society; it is known as "social evolution". Few, if any, inventions or cultural institutions have been the product of a single mind. These things have been the result of the work of a long line of experimenters, or the gradual development and working out of the institution which is the best adaptation to life conditions. Another distinguishing feature of social evolution is that it is not made permanent through the germplasm, but is handed down and accumulated as a "social inheritance" from generation to generation. Man may be the same man, organically, that he was twenty thousand years ago, but distinguishing between intellect and knowledge, between the capacity for knowing and things known, modern man is certainly the superior in knowledge of his Cro-Magnon ancestors. That is to say, modern man, or better, modern society, is the product of "social evolution"; and herein lies the difference of which we spoke in our introductory paragraph, which distinguishes modern man from his savage and barbaric ancestors. *"Civilization"* then, *is the product of social evolution.*

The next question which proposes itself is: "Is social evolution a logical process, that is, do men deliberately plan out and realize society's destiny?" We like to think that we choose our own paths and policies, consciously and purposefully, toward some selected end; that we have introduced a "rational selection" of plans and policies. But what moves men, the masses of men, is not thought, but emotion. And what sets emotion going is interest, for most men a very narrow and selfish interest.

To those who would like to believe that men think out society's destiny, this may seem the council of despair. However, it should be noted that it leaves out of account the operation of those cosmic, impersonal, automatic forces, which have thus far successfully directed the evolution of society—far more reliable and certain than any human act or acts could possibly be.

What is the use of a struggle if all is determined by such cosmic power? Well, man has done something with electricity, with gravitation, with the expansive power of steam, even though he knows little about the real nature of these forces. This has been done so successfully that he flatters himself into thinking he is the master and lord of nature. In reality he is nature's plaything; the earth shakes a little and his greatest works collapse. He has merely learned nature's ways and adapted his own actions to them. He cannot change gravitation, but he can place a mill wheel in the path of falling water. Similarly, the elemental forces of society cannot be mastered; they must be studied and conformed to. But intelligent adjustment to the known inevitable is as rare as automatic adjustment to the unknown inevitable is common. *Adaptation is certain because it is the very essence of life and comfort;* but of the two methods, intelligent adjustment is the more direct and less painful. "Of all earthly things, that which possesses the supreme capacity for swift adaptation is the human mind." But this capacity is undeveloped—is hampered by pseudo-knowledge, "second-hand" opinions, emotion, bias, and sentimentality. Nowhere is there such a need for real knowledge and science as in the social field.

A striking grasp of the fundamental principles underlying social progress, together with recognition of the unity of all civilizations, has resulted in a most worthwhile essay by Mr. Pierce. Mr. Pierce will be well remembered as the president of the Class of '24, and as a leader of student activities.

This paper was submitted in competition for the Cooley Prize, last May. In the judgment of the Committee of Award, it represented by far the best of the entrants, in that it had definite purpose and perfect co-ordination throughout. The concluding portion of the essay will be presented in the January number of THE ARMOUR ENGINEER.

Thus far we have defined social progress and have shown that such progress occurs as a result of the operation of certain social forces or "laws" which can be adjusted to—showing that *our civilization can be preserved.* Our next problem then seems to be: How best can we adapt ourselves to these social forces? As is often the case, such questions can best be answered from a study of the past. Let us seek for our answer among the pages of history.

We cannot here discuss and trace all phases of similarity in all civilizations. It would require volumes. Therefore, it will be our purpose in the next few paragraphs to present a perfectly general history which will apply to the rise and fall of any particular civilization, and by citing various examples, to indicate its general applicability.

The first few stages in our outline of civilization we must pass over with considerable brevity, interesting though this early period is. We speak of the "hunter-and-fisher stage", the "pastoral stage", and the "agricultural stage". However, we cannot fail to indicate a few of the social institutions characteristic of this period, so important are they to a thorough understanding of what follows.

In these stages, the family constitutes the principal social unit, and throughout this earlier period, continues to develop in strength and importance. (The clan and the tribe usually consist of the expanded family. See early history of any race.) Also during this period, organic evolution —the struggle with nature, possibly with wild beasts, with the invader and the marauder — tends to produce the hardy and military type. Land is here held principally in small parcels by freemen, for economic and social inequality has had little time to develop. The general type of mind is, in this period, still imaginative in character. It has no fear of material things, but, being imaginative, tends to give great importance to matters of a supernatural nature, which results in the introduction of religion. The need for physical protection results in the formation of a military class—at first the sole rulers. The need for protection from the supernatural results in the formation of the priestly class. These classes then work hand-in-hand for the benefit of both. (The Pharaoh of Egypt was a god. See also the history of any ancient nation. The theory of the "divine right of kings" has only recently received its death blow.) The code of morals of a savage or barbaric society is usually at best a crude thing, the result of custom and religion. But as society increases in complexity—say during the latter part of the agricultural stage—the moral code, through the medium of the agencies mentioned, may be expected to reach a high stage.

About this time — during the late agricultural period—commerce and industry arise. These and other activities permit the accumulation of wealth, and a tremendous change in society occurs. Here, in fact, is the point upon which all succeeding history turns. Slowly but surely a new class arises— the wealthy class. This class, because of its power of wealth, can buy the aid of the priestly and ruling (military) classes, and ere long becomes itself the ruling class. With the rise of this new class, another far-reaching change takes place. Heretofore the principal ambition of any individual was to distinguish himself on the field of valor. But now to be a great soldier is merely to find means of employment by the wealthy class for the protection of itself and its property—as a sort of policeman. This means that the evolution of the soldierly and imaginative type is superseded by the evolution of the economic type of mind.

The consequences of this change of the ascendant mental type reach to the very roots of society. The economic mind becomes more and more immune, as time goes on, to the threatenings of a god—the hereafter seems a long way off—and becomes entirely concerned with the satisfaction of its material wants and desires. The priestly class

(Continued on page 31)

EXPERIENCES OF AN ARCHITECT

By

C. E. WOLFLEY, '14

Editor's Note: We are pleased to present the readers of The Armour Engineer with a short account of the activities of an Armour graduate, Mr. C. E. Wolfley, '14. Mr. Wolfley's experiences will be especially intriguing to the student architects who will be confronted on graduation with his problems. The illustrations accompanying this article are taken from some of Mr. Wolfley's recent work. He is at present engaged in completing plans for a church in Forreston, Illinois, and will erect the Englewood Evangelical Church to be located at Marquette Road and South Peoria St., Chicago.

I AM sure that each member of the Class of 1914 looks back with amusement as well as concern when he remembers what happened shortly after Commencement on that memorable June evening at the corner of Thirty-third and "The Tracks." The writer for one was among those fortunate enough to have a position before graduation, and he was looked upon with envy by various members of the senior architects. But their envy was only wasted, as it proved to be not a position but a job. A little thing like salary was not discussed. A single look at the check representing payment for one week's work certainly opened the eyes of the graduate to the cruelties of the practical world. "Enough" said the Graduate. Thereupon he took his T-square and instruments, and, after bidding his home town farewell, hiked back to the city of his Alma Mater to renew the battle with a callous world.

My first real job was with George C. Nimmons & Company where the environment was very pleasant and where the opportunities for absorbing real practical knowledge were excellent. Like many good things, it was short-lived. The start of the world conflict dampened the ardor of the building public, and the forces of various architectural offices were cut in order to meet the new conditions imposed upon the world. For three months I drifted aimlessly, until the beginning of 1915, when building activity took on renewed life, and I found myself in the office of Tallmadge and Watson where I remained for three years. After a short period spent in the office of Graham, Anderson, Probst & White, I cast my lot with a Supervising Constructing Quartermaster in the Construction Division of the Army. The Quartermaster had some fifteen million dollars' worth of construction under his direct supervision.

Mr. C. E. Wolfley.

A few months after the close of the war, I entered the offices of Marx & Vigeant, where I remained until December 1, 1919. This date marked my entry into independent practice at Rockford, Illinois.

As a worthy alumnus has said, "In spite of all that we can do, and in spite of our own efforts to increase our business, our practices do seem to increase in quality and volume."

It seems that after a few years have elapsed between graduation and the opening of one's office, that such seems to be the case. I look upon it as the reward for holding out tenaciously against the discouragement of that period directly after graduation, when theory seems hopelessly lost in hard practical dimensions, amounts of radiation, height of stack, number of rivets, etc. One soon finds Theory and Practice beginning to clasp hands. After one has reconciled the two one suddenly realizes that the harsh world is not so cruel and cold as I felt when I gazed upon my first check for one week's wages.

Independent practice, especially when one is young is most amusing—and sometimes gratifying. One must be a salesman, and must study those with whom business dealings are to be made. For one surely must "sell" not only service but ideas in the form of the building to the owner. To them

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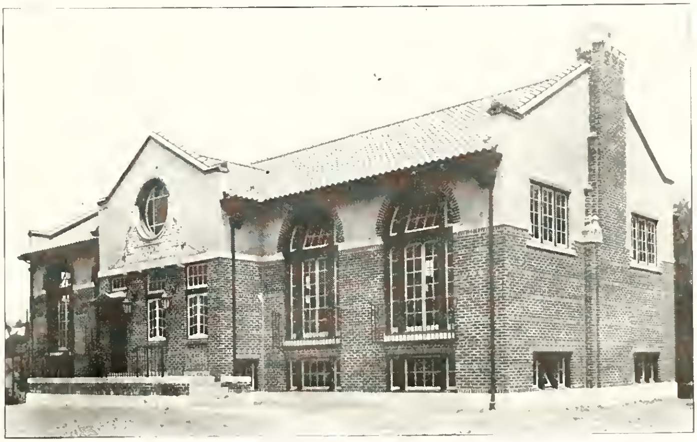

The Montague Library, Rockford, Illinois, was erected in 1922-23. It is of semi-fireproof construction costing in the neighborhood of $32,000 completely furnished.

MODEL AEROPLANES

THEIR DESIGN AND CONSTRUCTION

By

W. E. SCHWEITZER, '25

MODEL aeroplanes are divided into two classes, scale and flying models. The scale model is a semi-scale duplicate of the large machine, but its flying possibilities are limited because of the excess weight it must carry. It is used for wind tunnel experiments to determine the characteristics of the large machine before it is constructed. The flying model is void of all parts which are not absolutely necessary, and is actually only a skeleton plane. It is the flying model which we are going to discuss. Flying models are classified into three types: the twin push type, which has a small wing in the front, and the main wing and two propellers in the rear; the tractor type, which has a main wing, tail, and rudder; and the single push type, which has a main wing, a small wing in the front, and a propeller in the rear. By waterproofing the wings and placing small floats on the models, they can be made to rise from the water, or, by providing a landing gear, they can be made to rise from the ground. If the model is to be hand launched, all the landing gear is removed, as this would be only excess weight.

Rubber band motors have been found to give the best results for small sized models. They will deliver a large amount of power per ounce of material, and they are simple to handle. The model is driven by twisting the strands of rubber and allowing them to untwist, thereby turning the propellers. As the propellers are released, the power jumps to a maximum, and gradually drops away until, when the end is reached, the strands are untwisted. The r.p.s. of the propeller is greater at the start than at the finish. The average r.p.s. must be used in propeller design. This is one reason why rubber band motors are rather inefficient.

As the model is out of control after it once leaves the ground, the machine must be designed so that it will have inherent stability. This can be obtained by a large dihedral angle in the main wing, and an angle of incidence of some six to eight degrees in the elevator plane if the model is of the push type. In the case of the tractor type, this angle is in the main wing. The aspect ratio of the wings should be from five to seven. This is the ratio of the cord to span. It is problematical, because of the additional weight, whether the wings of the flying models under two feet span should be double surfaced, but it is thoroughly recommended that models above this span be double surfaced, because of the added efficiency.

As the supply of power from the rubber bands lasts only as long as it takes them to untwist, the length of flight is strictly limited, neglecting rising air currents which may unduly lengthen the flight. The problem of design is therefore this: with a given weight of rubber and a given machine the ratio of the weight of the rubber to the weight of the machine is the ratio which approximately determines the length of flight obtainable. If a machine could be built of zero weight, but carrying a supply of rubber, the power could be expended so slowly as to give a flight of indefinite duration.

This model, driven by compressed air, was built by Mr. Schweitzer.

The weight of the model includes that of the rubber, wings, propellers, frame, fittings, and, if the machine is a hydro-aeroplane, the floats, or, if a rise-off-ground type, the landing chassis.

The accurate formula developed by E. C. Cook to determine the greatest duration is:

$$D = \frac{K_y\; s'\; F\, E\, W_r}{(K_x + 0.0243\; s / S)\, W}$$

where

D = duration in seconds.

E = propeller efficiency.

F = ft. oz. of force in one ounce of rubber.

K_y = lift coefficient.

K_x = drift coefficient.

S = lifting surface in square feet.

s = equivalent dead head resistance.

W_r = weight of rubber in ounces.

W = weight of model in ounces.

As it is hard to determine K_y, K_x, and the propeller experiments, the approximate formula used is:

$$D = K \frac{W_r\, G}{W\, V}$$

where

K = 600.

G = glide.

V = velocity in feet per second, or $V = 8\sqrt{\text{loading}}$.

W_r = weight of rubber in ounces.

W = weight of model in ounces.

It can be easily seen that if the glide is high, the loading low, and W_r large in proportion to W, the possible duration will be great. The constant, K, was determined by experiment.

From the facts stated above, the following instructions should be followed when designing a model: make the model, with the exception of the rubber, the weight of which per foot ounce of force per ounce of rubber is constant, weigh as little as possible; have the largest surface possible; cut the head resistance down to a minimum; use the largest amount of rubber the motor base will stand; and use a factor of safety only high enough to stand the shock of the initial start into the air. Do not allow for accidents such as the planes striking the ground under full power, as this would necessitate too much additional weight. Use a high lift low speed wing section, since duration models rarely travel ten m.p.hr.

In the design of the propellers, probably the most difficult part of the

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THE ARMOUR ALUMNUS

PROF. J. C. PEEBLES, *Editor*

At the beginning of a new college year the Armour Alumnus has an important announcement to make. At the annual spring meeting of the alumni association held at the Auditorium Hotel on the evening of May 28, President Raymond announced that the Board of Trustees of Armour Institute of Technology had adopted a resolution providing for an alumni member of the board. The new member is to be chosen from the graduates of A. I. T. by vote of the entire membership of the alumni association.

This matter of an alumni member of the Board of Trustees is one which had interested graduates and former students for a number of years. They have felt that benefits would accrue both to the Institute and to the alumni if such representation on the governing board could be secured. Also, many of our graduates have been out of college nearly a quarter of a century and have reached such positions of trust and responsibility in the business and professional world as would fit them for membership on the Board. We believe that a man who has spent four years in undergraduate study at Armour Tech, and twenty or more in the successful practice of his profession has peculiar qualifications for service in assisting to shape the policies of the institution. Young men are being trained for the profession into which he has gone; he knows well from his own experience what their needs are, and is well fitted to assist in determining what their preparation shall be.

The Armour Alumnus feels that the action which provided for an alumnus on the Board of Trustees was brought about largely through the efforts of Doctor Raymond. He knows that a loyal body of alumni is essential to the growth and increasing usefulness of Armour Tech, and he believes that the assistance of the graduates and former students can best be exercised through representation in the governing body. So to President Raymond, we believe, belongs much of the credit for bringing about this very desirable result.

Immediately after Doctor Raymond's announcement, steps were taken to hold an election for alumni trustee. A nominating committee was appointed and arrangements made to take a letter ballot of the entire membership during the summer. In this way the new trustee could be chosen before the beginning of the next college year and be able to assume his duties this fall.

The voting resulted in the election of Roy M. Henderson, '02, as first alumni trustee. We believe that the association has chosen wisely, for among our entire list of graduates we can think of no one better suited for the position than Mr. Henderson. Most of our graduates left college since 1902, and so do not know our alumni trustee personally. In order that all may know as much about him as possible, the Alumnus presents herewith a brief outline of Mr. Henderson's career.

We believe that Mr. Henderson is splendidly qualified by training and experience to be our first alumni trustee, and we are proud to present him in this capacity to all who are interested in the future of A. I. T.

HENDERSON, '02, ALUMNI TRUSTEE

Roy Manwaring Henderson was born in Willoughby, Ohio, February 2, 1879. He was educated in the public schools of Topeka, Kansas, and Kansas City, Mo., and in the Kansas City High School. He finished his preparatory work in Armour Scientific Academy, after which he entered Armour Institute of Technology. He completed the four years' course in electrical engineering and also three years of the course in mechanical engineering. In 1902 he was graduated with the degree of Bachelor of Science in Electrical Engineering, and in 1906 he received the degree Electrical Engineer.

Mr. R. M. Henderson.

During his college days Mr. Henderson took an active part in all college activities. He was president of the Freshman class, assistant business manager of the "Fulcrum", published at that time by the Sophomore class, and manager of the "Integral", a book similar to the "Cycle" of today. He also was prominent in musical activities, being leader of the Mandolin Club, and manager of Glee and Mandolin Clubs. In social affairs he was chairman of the Junior Prom. Committee, and was largely responsible for the success of the most important social event of the year. He also went in for athletics, being an "A" man in baseball and track.

Men who were in college in the early days of Armour Tech will remember Ma Walsh's boarding house on Federal St., or Armour Ave., as it was known at that time. Henderson was first assistant kitchen mechanic at Ma's place, finding time to earn part of his college expenses

(*Continued on page 18*)

WE HAVE WITH US TONIGHT:—

$$A\,I\,T \int_{1897}^{1924} dt$$

In the lobby of the Auditorium Hotel, at the foot of the stairs leading to the mezzanine floor, three young men are standing. It's a "big night tonight" for A. I. T. Alumni Association, and these men are the reception committee stationed there to help start the affair off with a bang.

The young fellow at the right of the stairs has a gorgeous smile and a gripping hand shake, and he seems to know everybody. He is able to spot an Armour man as far as he can see him, and when he greets a new arrival the latter is sure that the reception committee is there for no other reason than to welcome him alone. That's the ultimate in tribute to the "glad-hander", well deserved in this case. What a wonderful "come-on" artist was spoiled when Jeff Corydon took up engineering!

The young man in the center of the stairs sees many faces which he does not recognize. He is there for a special and definite purpose, to greet the members of his own class of 1924, attending their first alumni gathering. They are coming in now, seldom singly but usually in groups of three or more, as if to gain courage from numbers. Elmer Biever, of course, knows them all; he sorts them out of the crowd, assures them that they are in the right place, and starts them up the stairs.

The man at the left of the stairs is wondering where so many boys came from. It seems to him as if the graduates of his day were older and more mature than the lads whom Biever is now gathering in. Perhaps they are, and then again perhaps his viewpoint has changed; he recalls that youth and maturity are relative and many-sided, the impression which the observer gets depending upon the facet which he sees. But the third member of the reception committee soon forgets his musings in the immediate demands of his job: graduates of a decade or more ago are coming in, and he is there to meet them. Many of them have not attended an alumni affair for years, but when Arthur Baum calls them by name, and welcomes them with a smile and a handshake, they feel immediately that they still belong to us.

Upstairs on the mezzanine floor the S. R. O. sign is out. The room is in an uproar of noisy greetings as men recognize classmates and other friends whom they have not seen for months, perhaps years. Many members of the faculty are present, trying desperately to recall almost-forgotten names to fit well-remembered faces. Down at one end of the room a big handsome fellow with that school-girl complexion and a permanent wave has mounted a table and is urging the crowd to take the elevators to the ninth floor, where the dinner is to be served. "Atta-boy, Lawrence, show us where we eat", indicates that no further urging will be needed, and the

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ARMOUR ALUMNUS

(Continued from page 17)

in addition to all his other activities. He is also a fraternity man, a member of Phi Kappa Sigma.

Mr. Henderson was married in 1903 to Marian P. Clarke, a graduate of the Armour Scientific Academy in the class of 1900. They have two sons, twenty and seventeen years of age, respectively.

After graduation, Mr. Henderson went to Mexico, where he was draftsman and electrical engineer for the Mexican Central Railway. His work was chiefly in the design of tool and power equipment for the new shops which they were building at that time. Later, he became Superintendent of Construction, and had entire charge of the installation of equipment in the new shops.

After two years in Mexico, Mr. Henderson returned to the U. S. and secured a position with the Arnold Company in Chicago. At that time, the company was donig a large amount of work in the design and construction of railway shops. Henderson was made superintendent of construction for the Missouri Pacific Railway shop, at Sedalia, Mo. Later he was chief draftsman and engineer for the Arnold Company, in charge of the design and construction of various railroad shops, industrial plants and power stations.

In 1907 Mr. Henderson entered the employ of Stone & Webster in Boston. Here he was construction engineer for two years, and assistant construction manager for six years. In 1915 he became district manager for the company in the Chicago territory, in charge of construction work and new business in the middle west. During the war he was sent by Stone & Webster to the American International Shipbuilding Corporation, Hog Island, Pa. Here he was employment manager in charge of organization, employment, and industrial relations departments, which were responsible for the building up of a working force of 35,000 men. Mr. Henderson also assisted in creating a ship mechanics training school which converted unskilled and semi-skilled labor into specialized mechanics in the shipbuilding trades.

At the close of the war Mr. Henderson went with Dwight P. Robinson & Co. as construction manager. In 1919 he became vice-president of the company, in charge of construction and new business, which position he still holds. He is also vice-president and director in various subsidiary corporations controlled by Dwight P. Robinson & Co.

Mr. Henderson is a Mason, a Shriner, a member of the Sons of the American Revolution, the American Institute of Electrical Engineers, and the Western Society of Engineers. He belongs to the Engineers' Club, the Uptown Club, and the Railroad Club, all of New York; also Phi Kappa Sigma, of New York. He finds time to play golf, being a member of the Douglaston, Long Island, Country Club. He is also a member of Union League Club, Chicago.

During his long career as a construction engineer Mr. Henderson has built steam power plants aggregating nearly one million K. W. capacity; gas plants in a dozen different cities; several hydroelectric plants; many hundreds of miles of power transmission lines, and industrial plants and monumental buildings costing more than one hundred million dollars.

ALUMNI PICNIC

On the afternoon and evening of Sept. 5, an A. I. T. alumni picnic was held at White City. A short business meeting was held in the afternoon, when the result of the voting for alumni trustee was announced. Later an indoor-outdoor ball game was staged between teams captained by Rochlitz and Goppelsroeder. Doctor Raymond played on Rochlitz' team, but in spite of Prexy's best efforts their team got licked. The play was stopped at the end of the fifth inning, due to the exhaustion of everyone in the game, including the score keeper. The latter had worn out two pencils and completely filled a new score book. We refuse to tell the score.

Several of the old-timers were present, the first graduating class being represented by **W. F. Sims, '97. O. A. Rochlitz, '01,** newly elected president of the alumni association, proved to be a regular Babe Ruth with the bat, but a trifle slow on the bases. Everybody had a good time and a similar affair may be tried again next spring.

ALUMNI LUNCHEONS

The place for the Tuesday noon luncheons has been changed from the Hamilton Club to the Central Y. M. C. A., 19 S. La Salle St. The luncheons are held every Tuesday at 12:30 P. M., and it is hoped that just as many Armour men as possible will get into the habit of coming. You must lunch somewhere, so why not come to the Armour luncheons and meet some of the old crowd?

The large number of improvements which the city of Chicago has recently undertaken has resulted in the organization of a division of design in the Board of Local Improvements, known as the Bureau of Design. At the present time this division is working on the South Water Street project which involves some quite intricate problems. We are glad to know that Armour Tech is well represented in this force which is considered a highly efficient and practical one. The following are the Armour men on the Bureau of Design of whom the "Engineer" is glad to hear.

Frank A. Coy, '04, may be remembered by the old-timers as the youngster with a joke ready to suit every occasion. Mr. Coy before coming to the Board of Local Improvements, where he is now employed as designing engineer, was for years in charge of the design of buildings for Batty & Ripp, Engineers and Contractors, and spent much time on the construction of railroad terminals and shops at Denver, Colo.; Salt Lake City, Utah; Grand Junction, Colo., and other western points.

Joseph L. Duffy, '15, has the same smiling face he had ten years ago. Mr. Duffy states that for a year after graduation he saw more of the country than he wanted to see, so he has stayed in town ever since. Mr. Duffy was in charge of the Concrete Department of the Leonard Construction Co. for four years, and then was employed for the last three years by the Sinclair Oil Co. where he assumed charge of the Architectural Department and Concrete Design. He remained there until recently when the offices were moved to New York and he declined to go there. Mr. Duffy is a structural engineer and is now in charge of a section at the Bureau of Design.

Benjamin F. Morrison, '22, is another Armour man who is doing credit to the Institute. Last year Mr. Morrison received the Structural Engineers' license and is now engaged in the erection of private structures in addition to his position as designing engineer. We're sure his friends will be glad to know that Mr. Morrison was happily married shortly after graduation. No, you guessed wrong, there is no junior, as yet.

William K. Lyon, Jr., '21, is surely remembered. He has been with the Board for the last three years in various capacities, and he is now working on the South Water Street project as a designing engineer.

A. Stein, '20, is now with the Board and is assisting in the design of South Water Street. Mr. Stein has been married for three years and is the proud father of a son.

Milton B. Simpson, '23, is another man who stayed in Chicago when Sinclair Co. moved to New York. He is now employed by the Board as a draftsman.

Robert Mayo, '23, came back to Chicago from New York where he was employed on the construction of a tunnel, and is now with the Sanitary District as a junior engineer on the construction of a tunnel at the Howard Ave. sewage disposal plant. Bob may be remembered as the originator of the famous ten thousand mile hike, his adventurer's club, and his Chicago to Trout Lake hike.

We are glad to hear from **Gene Niederhofer, '24.** Mr. Niederhofer is at present with McLinock Marshall Co., Pittsburgh, Pa., and is also attending Carnegie Tech. for a postgraduate course. He adds that next month he will leave Pittsburgh for Milwaukee where he intends to stay for a considerable time. We are informed, however, that Mr. Niederhofer is to return to Pittsburgh after his impending marriage at Milwaukee. Gene is well remembered by the present students for his fellowship, activity and scholarship.

Louis Pfohl of the Civil class of 1924 is with the Chicago City Architect. The fact that Louis finished Armour in record time has not changed his pace. He may now be seen rushing up the stairway of Chicago-Kent College of Law where he is taking a legal course, and setting the pace in the class rooms. Mr. Pfohl is a recognized rusher. After rushing all the Profs in the Civil department, and the instructors at Kent, he rushed a young lady in his home town, Dubuque, Iowa, and they are now engaged to be married some time in the future.

Capt. Chas. L. Bolte, '16, is located in the Army and Navy Bldg., Washington, D. C. He is personal aid to Chief of Staff, Gen. John L. Hines.

F. M. Davison, '18, is with the Kentucky Highways Commission in charge of the highways of eastern Kentucky. He is now making a tour of the west coast roads from Seattle to Los Angeles.

Lee Cardwell, '20, is still in Johnson City, Tenn. He has become quite prominent as an architect "down in Dixie" Tennessee.

N. H. Erlandson, '23, was recently married. He is with the Engineering Department of the Public Service Co. of Northern Illinois.

C. H. Bockman, '24, is with the U. S. Gypsum Co. During the summer, "Chuck" has been superintending a num-

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EDITORIALS

TACT

Probably one of the outstanding faults of budding engineers is too great self-immersion in those concerns immediately at hand; a delving and groping along lines of strictly personal interest. Our troubles and problems bulk so high that a great deal of the outside view, which is usually quite calm and serene, is shut out: we appear to be surrounded by a raging storm of difficulties, which, impersonally considered are insignificant.

How can we best avoid this attitude? By cultivating tact. We prefer to define tact with the old darky, who said, in essence, "Tact? When yo' got it, no one knows it; when yo' ain't, no one don't know it." Tact means putting yourself in the other man's boots, getting his viewpoint, seeing things through his eyes. The aspect must be changed from subjective to objective.

The practical value of cultivating an objective attitude is inestimable. All organic life succeeds in living only in so far as it can adapt itself to its environment, which includes all other organic life. As engineers we must deal not only with materials and equipment, but also with men. All our purposes will be largely achieved through human relations.

Be it resolved therefore that:

We will cultivate tact, in order that we may not ignore the first member of that all-important trio, men, materials, and equipment.

THE SELECTION OF ENGINEERING STUDENTS

A few months ago, a Freshman Class of over two hundred and forty students entered the Armour Institute of Technology. Of these from fifty to fifty-five per cent will be graduated on the completion of their chosen courses of study. Of the remainder, a few will have transferred, some will have left college for strictly personal reasons, while a certain number will have dropped out due to inability to maintain their scholastic standing. What can be done for this last group? A year ago, editorial mention was made in The Armour Engineer of the investigation being conducted by the Society for the Promotion of Engineering Education for the purpose of determining "the objects of engineering education" and examining "the fitness of engineering curricula and teaching processes." A section of the report of progress by the Director of Investigation is devoted to a discussion of the problems of admission of the engineering college.

It is recognized that the average graduate of a secondary school is an insufficient judge of his own fitness for technical training. Thus the engineering college cannot assume that a proper vocational sorting has taken place among the boys who present their high school credits for admission. To quote from the report: "A survey of contemporary opinion among competent psychologists reveals practically unanimous agreement that the foundations, of maturity, knowledge of self, knowledge of different fields of human effort, and stabilization of interest needed for valid vocational differentiation do not exist among the vast majority of high school graduates. Further opportunity for self-discovery and a broader outlook on life is needed before an educational program of definite vocational aims can be attempted with confidence. The early years in college are apt to remain a sorting ground for some time to come." This is a frank confession of the need for a scheme of selection which will place in the engineering college the student who may be classed as a "good risk" for an engineering education.

Several solutions of this problem have been proposed. It has been suggested that the candidate for admission be required to complete two years or more of pre-professional college work before entering the engineering college. The more mature judgment of the student would, it is hoped, operate to secure a sound choice of a field for further effort. Ideally perfect though it may be, it is not anticipated that such a plan would provoke any great degree of enthusiasm upon the part of the student who, indeed, often frets at the present four year system.

A second process of selective admission would place the responsibility of choice upon some impartial agency, which would seek to determine, within the student, "the group of personal attributes which are most significant in predicting success in engineering study, and if possible, in predicting engineering achievement." This scheme would involve the identification of those qualifications which an engineer, or an engineering student should possess and the devising of tests by means of which these qualities might be discovered within an individual. Although this plan would be placed upon a rational, scientific basis, at first blush it sounds suspiciously like fortune telling. Such qualities as good judgment, mental courage, or initiative, undoubtedly essential to the engineer, are difficult to determine in a man, unless he be under observation for a long period. Furthermore, it is no easy matter to differentiate between those characteristics which the engineer should possess and the qualities requisite for success in any field. However, although accurate and final graduation is by no means presumed, a thorough investigation and the collection of sufficient data, the co-operation of both engineers and educators being secured, may accomplish the elimination of these difficulties.

The enormous practical value of some reasonable plan of selective admission to the student, to the institution, and to the engineer who employs the graduate of a technical college is so apparent that a consideration of this problem is entirely worthy of our time and attention. The very discussion which accompanies the suggestion of any scheme is sure to awaken new interest; constructive criticism is bound to add to the fund of knowledge and opinion out of which will come the ultimate solution.

COLLEGE NOTES

In our eagerness to welcome the Freshman, we are likely to forget that the growth of the faculty is keeping pace with the development of the Institute. THE ARMOUR ENGINEER is pleased to welcome a number of additions to the teaching corps.

Mr Walter S. Seegrist, instructor in Descriptive Geometry and Elementary Machine Drawing, is a graduate of Purdue University. Mr. Seegrist has had four or five years of experience in industrial work, as an electrical and mechanical engineer.

Mr. Donald E. Richardson, instructor in Electrical Engineering, is a graduate of Armour, class of '24. During the summer, Mr. Richardson married Miss Bernice Aileen Kelly. He claims that his desertion of bachelorhood was "the best thing he ever did." Congratulations!

The Department of Architecture is exceedingly fortunate in having secured the services of Mr. William Jones Smith as critic in Senior Design. Mr. Smith is a Diplomé of the Ecole des Beaux Arts and a student of Redon, as well as a graduate of the University of Pennsylvania. Mr. Smith is a partner in the firm of Charles & Smith, Architects, Chicago.

He will be assisted by Mr. W. J. O'Connor, a graduate of Armour, class of '20, and also a student of Redon in the Ecole for the past three years.

Mr. R. J. Nedved, A. I. T., '21, has charge of Freshman Design. Mr. Nedved has traveled in Europe for the last year, as a holder of the Chicago Architectural Club Scholarship.

Even as we welcome recent accessions to the faculty of the Institute, we announce with regret the resignation of Mr. Edmund S. Campbell as head of the Department of Architecture. Mr. Campbell has been recently appointed Dean of the Beaux-Arts Institute of Design, with headquarters in New York. His appointment is significant in that it calls universal attention to his record as an educator in the field of architecture and to the success which the Department of Architecture at Armour has enjoyed while under his direction.

The Department of Architecture is a large and important division of the Armour Institute, numbering one seventh of the whole student body. The fame and advertising that "the Architects" have brought to the Institute and to the City of Chicago has been national and even international. The fact that Armour men have won the two biggest competitions in America during the past year is sufficient acknowledgment of the high plane of achievement inaugurated by Professor Campbell while head of the Department.

It is perhaps the natural thing to mourn the loss of such a man to the Institute, yet we are fortunate in that the foundations he laid remain. The work of the Department of Architecture is being carried on under the guidance of Mr. Earl H. Reed, professor of Architectural Design. The impression left by Mr. Campbell will remain as an inspiration and a stimulus to every man in the Department of Architecture. The best wishes of the Armour Institute for success go with Mr. Campbell in his new work.

HARRY CLAY COFFEEN

It is with great sorrow that we chronicle the sudden death of Henry Clay Coffeen, a former instructor at the Armour Institute of Technology. Mr. Coffeen died on Sunday evening, September 14, while canoeing in Lake Michigan, off Waverly Beach, Tremont, Indiana.

Mr. Coffeen was born in Champaign, Illinois, on July 27, 1877. He was graduated from the University of Illinois in 1898. While a student of Illinois, he established a reputation for being both scholar and athlete. Track captain, member of the football team, and Sophomore class president, he also belonged to Phi Gamma Delta and was elected to Tau Beta Pi. He held a fellowship at Illinois the year after he graduated and a scholarship at the University of Pennsylvania the following year. He taught drawing at the University of Illinois, 1900-02, and served as instructor and assistant professor in Machine Design at Armour Institute from 1902 to 1911. He was president of the Faculty Club in 1909 and Faculty Manager of Athletics, 1905-11. Since 1911, he had been affiliated with the Northwestern Mutual Life Insurance Company as a special agent and an insurance specialist. A loyal Illini, Mr. Coffeen did not allow graduation to terminate his interest in his Alma Mater. Only last June, he was elected president of the Alumni Association of the University of Illinois. The vigor with which he entered upon his new duties and responsibilities, remaining at the same time faithful to his regular tasks, was only characteristic of his capacity for work and his willingness to serve.

Who can estimate the profound influence this man must have had upon the college men with whom he came in contact as professor? The story of his life is a lesson in service and a sermon in hard work. He has left that life, but the mark he impressed upon the world remains—a true witness to the goal to which the college man should strive to reach.

EDWIN A. LOMMEN, '25

We regret to announce the death of E. A. Lommen, '25. Mr. Lommen died at his home in Sioux Falls, South Dakota, July 21, 1924. After a period of illness due to tonsilitis he succumbed to pneumonia.

Mr. Lommen was a student in the Department of Civil Engineering. He maintained an active interest in class affairs. At the time of his death he was president of Alpha Gamma Chapter, Theta Xi Fraternity.

JOAN ARMOUR

We were deeply grieved to learn of the recent death of Joan, the one year old daughter of Mr. and Mrs. Philip D. Armour III, after an illness of but a day. Mr. Armour is Vice-President of the Institute, as well as a member of the Board of Trustees.

The affairs of the Senior Class upon its "last lap" have been entrusted to the following officers:

President	M. F. ADAIR
Vice-President	J. M. SHOEMAKER
Treasurer	W. H. SOTHEN
Secretary	J. B. WHITE
Sergeant-at-Arms	J. K. STAHL
Social Chairman	G. J. TAYLOR

That these men might not be burdened with too many duties, committee chairmen were chosen to assist in the preparations for graduation.

Picture	A. A. ANDERSEN
Jewelry	E. W. ODENWALDT
Program	W. H. WEINWURM
Cap and Gown	J. G. JOHNSON
Auxiliary	H. P. WHITEHILL

Don't be surprised if J. P. Morgan soon has a rival. The Seniors confidently expect this to take place, since 'Gene Odenwaldt, Junior Class treasurer of last year, turned over a surplus of $131.55 to the Senior Class fund.

Equal parts of good judgment and enthusiasm characterized for the first Junior Class meeting of the year. Keeping in mind that sterling slogan, "For as the Junior Class goes, so goes the nation," the Juniors chose capable men for all positions. Junior Class Officers:

President	A. J. DANZIGER
Vice-President	C. W. BARGER
Treasurer	W. A. DEAN
Secretary	S. J. MCLAREN
Sergeant-at-Arms	C. J. HOLLINGER
Social Chairman	D. B. DAVIDSON
Junior Marshal	H. J. PREBENSEN

The Sophomore Class organized on September 18. Despite the fact that the Sophomores began to get hungry when the noon whistles blew, their meeting resulted in a wise selection of officers. The Sophomores are confident that it was also a selection of wise officers. The men elected are:

President	J. W. TASKER
Vice-President	C. LONG
Treasurer	F. D. PAYNE
Secretary	H. T. MORAN
Social Chairman	R. C. PEACOCK

Business is reviving, trade is increasing, and conditions are entirely normal once more, for the Freshman Class election has been held. The results of this important event follow:

President	F. DAVIS
Vice-President	J. NASH
Treasurer	W. D. ALLEN
Secretary	M. A. HOTCHKIN
Social Chairman	G. E. TUCKER
Sergeant-at-Arms	T. OGDEN
A. T. A. A. Representative	M. B. TRACY

Despite the best efforts of Jupiter Pluvius to limit the attendance, the Freshman Handshake was voted a success by all who were present. The Armour Y. M. C. A. is to be congratulated upon its efforts to widen the circle of acquaintances of the Freshman at the Institute.

It is forever the pleasure of The Armour Engineer to record the success of Armour men. The 1924 Paris prize of the Society of Beaux-Arts Architects was awarded to Harry Kurt Bieg, of the class of 1922. Although this was the seventeenth annual award, it was the first time that the prize had gone to a Chicagoan. Mr. Bieg will become the guest of the French government for two and one half years, receiving $3,000 for living and traveling expenses. The problem consisted in the planning of a " 'transportation institute' to house a great private foundation whose funds are devoted to the study of all means of transportation." The feature of Mr. Bieg's design was a great steel shaft over the center of the building, to be used for the purposes of radio or for the mooring of aircraft.

Professor McCormack and Mr. Bentley attended a meeting of the American Chemical Society at Cornell University, Ithaca, New York, during the second week in September. They were most impressed by the building in which the society met. This is a million and one-half dollar structure, the gift of a Cornell alumnus. It is occupied solely by the chemical department of the university.

Defense day, September 12, was fittingly observed by the first assembly of the year. The assembly was addressed by Dr. W. A. Evans, former Commissioner of Health of the City of Chicago and the familiar "Docevans" of the Chicago Tribune. He emphasized the importance of national good health as a preparedness measure.

On Tuesday, October 7, we were delightfully entertained by Mr. Geoffrey O'Hara, a composer and musical genius, at an assembly given under the auspices of the Duo-Art Piano Company. Mr. O'Hara is a close friend of our own Mr. Amsbary, having traveled the chautauqua circuit with him for two seasons. He revealed to us the beauty and simplicity of music in a manner that will not be soon forgotten.

On September 11, the first Thursday of the college year, "Freshmen only" were bade to the Mission to receive the welcome of the Armour Institute and to be introduced to the duties of Armour men. They were impressed with the idea that college is a partnership, the student sharing in the risks, profits, and reputation of the institution. We hope that the good advice they were given will stick.

The Senior Informal

The Senior Class, on October 24, opened the social program of the season with an informal dance, given in the Tiger, Gray, and Crystal Rooms of the Hotel Sherman. The enchanting music of "Jinks" Bryan's Collegians filled the newly and beautifully decorated rooms. Social Chairman Taylor and his committee are to be highly congratulated upon the energy expended to make this dance a "Seniors' farewell" and an event of high rank in the annals of class dances at the Institute. The large attendance served to reward their efforts, and to encourage the other classes to achieve similar success in their own social functions.

SCHOLASTIC STANDINGS

The following statistics, compiled by the Office of the Dean, give the scholastic standings of the members of the Freshman, Sophomore, Junior and Senior Classes of the College of Engineering and Architecture, who were in attendance during the second semester of the school year 1923-1924. In this computation the grades in Physical Training were omitted. A credit (Cr.), either for work at the Armour Institute of Technology, or for work elsewhere was considered equivalent to a grade of "B."

The average of the entire school body, a total of 672 students is 86.8 per cent.

The averages of the various organizations are as follows:

The Senior Class	88.7%
The Junior Class	88.1%
The Sophomore Class	86.4%
The Freshman Class	84.9%

The student with the highest average in the Senior Class is Mr. John Henry Sweeney. His average is 95.5%.

The student with the highest average in the Junior Class is Mr. Milton F. Adair. His average is 95.3%.

The student with the highest average in the Sophomore Class is Mr. Arthur S. Hanson. His average is 96.6%.

The student with the highest average in the Freshman Class is Mr. Isaac B. Lehman. His average is 95.7%.

Mechanical Engineering Department	87.3%
Electrical Engineering Department	86.2%
Civil Engineering Department	87.3%
Chemical Engineering Department	87.1%
Fire Protection Engineering Department	86.3%
Architectural Department	84.1%

The Honorary Fraternities

Tau Beta Pi	92.6%
Eta Kappa Nu	90.5%
Scarab	87.0%
Phi Lambda Upsilon	91.3%
Salamander	91.6%
Chi Epsilon	92.7%

Social Fraternities

Phi Kappa Sigma	85.5%
Delta Tau Delta	86.0%
Theta Xi	86.4%
Sigma Kappa Delta	86.9%
Phi Pi Phi	86.4%
Triangle	86.0%
Sigma Alpha Mu	88.1%
Rho Delta Rho	87.3%
Beta Psi	88.8%

Clubs

Sphinx	89.5%
Umen	89.3%

The average of all students belonging to the Phi Kappa Sigma, Delta Tau Delta, Theta Xi, Sigma Kappa Delta, Phi Pi Phi, Triangle (Fraternities that rent or own their own chapter houses) is 86.2%.

The average of all other students is 87.2%.

In the above the following numerical values were given to the letter grades:

A	97.5%
B	90.0%
C	80.0%
D	67.5%
E	50.0%
Cr	90.0%

THE JUNIOR "THANKSGIVING HOP"

The Junior informal dance will be held on Friday evening, November 21, at the Opera Club, 18 W. Walton Place. The entire Opera Club is being re-decorated at present time and the Junior "Thanksgiving Hop" is to be the first affair given there after the work is completed. The music will be furnished by the "Seven Spiders" who have established an enviable reputation for themselves at the Channel Lake pavilion during past summers.

The Junior dance will be the last social event at Armour Tech before the Thanksgiving holidays. The Juniors are confident that the date, the place, and the music are sufficient reasons for a record crowd at the "Thanksgiving Hop".

108th Ordnance Company

Since the appearance of the Ordnance Company trucks at Armour Tech and the talk of Lieutenant M. C. Adams at the Defense Day assembly, there is no need to tell the "who, when, and why" of the organization.

August 9, the Company entrained for Camp Grant, arriving at Rockford in the evening of the same day. There followed two weeks of intensive drill, guard duty, and reviews, with occasional relaxation, furnished by K. P. duty. On August 23, a sun-burned outfit with calloused hands, yet grinning faces, broke camp for home. Arriving in Chicago that evening, they made a mad dash for Mother's table.

The camp period was a profitable one. The organization went into camp with one decrepit Dodge Light Repair truck and emerged with two 12-ton, four wheel drive Heavy Artillery Repair trucks, an additional Dodge, and two 5-ton Transport trucks. Upon return to the home station, the enlistment curve took a decided jump and has yet to reach a maximum point.

Lieutenant Barrie of the Ordnance Department, U. S. A., has been assigned to the unit as ordnance instructor and is giving a valuable course of instruction for those who wish to avail themselves of it. Drills are held every Friday evening at 8 P. M. at 115 E. Ontario St.

Registration First Semester 1924-25

	Seniors	Juniors	Sophomores	Freshmen	Specials	Total
Mechanicals	33	25	40	17	..	145
Electricals	29	40	54	57	1	181
Civils	14	24	28	51	..	117
Chemicals	23	15	23	16	..	77
Fire Protection	19	20	33	34	..	106
Architects	13	24	23	12	1	103
Total	131	148	201	247	2	729

THE ARMOUR ALUMNUS

(Continued from page 18)

ber of construction jobs in the sunny south.

F. E. Sloan, '23, is in architectural work with the firm of Folz and Brand. He has designed several attractive buildings now under construction in the city.

R. P. Jensen, '23, is "rating" the city and nearby towns for the Fred S. James Co. He has been under **A. M. Jens, '04,** and with **E. W. Giesler, '21,** of this company.

"Friction" Tarrant, '23, and **"String" Kneupfer, '15,** are engaged in the manufacturing business in this city. Their firm is known as The General Engineering Works.

Albert and **Julian Hayden, '07,** are located in Estes Park, Colo. They have been pioneer residents of Estes Park Village and have done much to make it what it is at the present time. One of the newer developments in the Park known as "Broadview" is fostered by them.

W. J. O'Connor, '20, has been added to the Faculty of the Institute. He may be found at the Art Institute in Chicago.

Elmer Beiver, '24, traveled through Europe last summer, and, although badly shaken up upon his return aboard the Arabic when she struck the tornado, is back to tell the story.

George Stantial, '23, is still with the Illinois Malleable Company working in the engineering department.

IT'S STANDARD PRACTICE

C. A. Herbst was married to Miss Clara Shick, June 14, 1924.

L. G. Miller and Violet L. Sutcliffe were married June 18, 1924.

R. O. Miles and Helen L. Neil were married June 28, 1924. They are living in Minneapolis, Minn.

D. E. Richardson, '24, instructor in electrical engineering in A. I. T. was married to Bernice A. Kelly, July 17, 1924.

E. M. Seaberg and Grace B. Unverferth were married Sept. 1, 1924. "Sea" is with the U. S. Gypsum Co. in Chicago.

Roy Goppelsroeder, secretary of the alumni association, would like to locate as many as possible of the men in the list below. He is making a strong effort to bring our roster up to date, and would appreciate any information about the men in this list. Mail sent to the latest address that we have has been returned and they are lost to us unless we can get information about them from some other member of the association. If you know where even one of them is, write Roy Goppelsroeder, 251 Conway Building, Chicago, or the Armour Alumnus, care of A. I. T.

Name	Last Address
Louis Zable	1047 Leland Ave.
Augustus B. Cornwell	Cedarville, Ill.
Thomas Bjorge	1426 Rural St., Rockford, Ill.
J. F. Mathis	828 Monroe St., Gary, Ind.
Earl E. Edgecomb	Indianapolis, Ind.
John J. Schmidt	2302 N. Delaware St., Indianapolis, Ind.
Edwin C King	Boone, Iowa
Joe Benson Bidwell	3701 7th Ave., Sioux City, Iowa
Horace B. Kinney	Plymouth, Mich.
Maurice T Jones, Jr.	Evansville, Ohio
Herbert S Walin	Suite 58, Pasadena Apt., Winnipeg, Manitoba, Canada

WE HAVE WITH US TONIGHT:

(Continued from page 17)

gang makes a mass assault on the elevators.

In the dining room places have been prepared for more than four hundred, and every chair is soon occupied. Tables have been reserved for each of the classes from 1897 to 1924. The former has only a few members present, the latter nearly a hundred. There are Tech. yells and class yells, many which present-day undergraduates have never heard.

During a moment of comparative quiet, the toastmaster, E. H. Freeman, '02, finally makes himself heard. He extends the welcome of Armour Tech Alumni Association to the new members, the class of 1924, who are grouped in the center of the room. Just as E. O. Pierce, president of the class, rises to respond, the waiters pull a boner by bringing in the soup. Mr. Pierce struggles manfully against hopeless odds, but only those near his table are able to hear him. Because of this lack of co-ordination between the toastmaster and the headwaiter, a perfectly good speech is spoiled.

Immediately after the important business of eating has been finished, some special stunts are put on for the entertainment of the crowd. "Gypsum" Smith, '10, mounts a platform at one end of the room and announced that certain contests have been arranged, and that for each contest the best man in each class is to be entered. The first event on the program is the "tall and slim" contest, and in as much as a number of Armour men have risen quite high in the world, the platform is crowded with entrants. One likely candidate refuses to enter; he declares that he has won so many such contests that he should be barred by the statute of limitations. So Roscoe Harris sits quietly in his seat and watches novices perform in a field where he is an expert.

It is decided that the basis for scoring this event shall be height divided by waist measure. The contest proves to be pi for "Skinnay" Marks, '20, his score of 3.1416 simply running circles around all other competitors. Professor Huntly is second with a score of 3.05, a waist measure of twenty-six inches being so large as to put him out of the running.

The next event is the "short and fat" contest, scored on a basis of weight multiplied by waist measure and divided by height. "Shorty" Deveney, '10, brings home the lard with a score of an even two hundred. It is discovered that his height and waist measure are equal, so they cancel out of the equation, leaving only weight. Professor Campbell solves the equation by which Deveney won, although apparently much disappointed that some one of his former students have not seen the solution.

Space is lacking to describe all of the events on the program, but the spirited contest waged by the fundamentalists cannot be passed over in silence. It should be explained that they are the ones who believe in a literal interpretation of all the events of sacred history, together with a personal application of all its laws and mandates. This includes the famous injunction to Noah and his sons—"Multiply and replenish the earth." Clarence McDonald, '04, wins this contest with a factor of seven, closely followed by Professor Finnegan whose factor was six. Amid great enthusiasm Mac carries off the prize, a ten room house on a one hundred foot lot, while the band played "The McDonalds Are Coming".

After the contests are finished the crowd quiets down and the toastmaster presents President Raymond. The reception which he receives is spontaneous and vociferous, a wholehearted expression of genuine affection. Doctor Raymond has an important announcement to make, on a subject which has interested the alumni association for a number of years. He states that the Board of Trustees of A. I. T. has adopted a resolution providing for an Alumni member of the Board, to be chosen by the alumni association. Thus quietly and efficiently, through the efforts of one man, is brought about a result for which the alumni have worked for years.

Next, the toastmaster presents Dean Monin, and he too receives a splendid reception. As he stands straight as a Norway pine, before more than four hundred of his boys, as he calls them, one feels that he, together with President Raymond, enjoy their affectionate regard more than any other member of the faculty. Others have taught them their "bread and butter" courses, the work-a-day subjects which form the basis of their profession. But Dean Monin has dealt more in things of the spirit, and has grown to be, in a measure at least, a personification of the things he taught. In the presence of a scene like this one feels that after all we may not be so material as our name implies.

During the entire evening four men have been sitting at one end of the speaker's table. They are neither alumni nor professors, yet they have important duties to perform in the daily routine of Armour Tech. The crowd is anxious to have a few words from each of them, feeling sure that what they will say will be different from the usual after-dinner speech. So the toastmaster presents the man at the extreme end of the table and asks for a few words. He is a large, powerfully built man, with iron gray hair and blue eyes; he is quiet and retiring in manner, but nothing escapes his notice. After a moment of hesitation he arises: "I am glad to see you letting off so much steam tonight; my experience teaches me that a safety valve is a mighty important attachment for either a steam boiler or a man. But why don't you fellows come oftener to these affairs and make sure that the old safety valve is in good working order? Sometimes, you know, they get stuck from disuse and that's bad for both man and boiler. I am glad to be with you tonight; to see so many familiar faces, and also to recall the times when some of you turned steam on the Corliss engine without opening the exhaust valve, and then wondered why it wouldn't go. But you know better now; you are getting along in your profession and I wish every one of you all the success in the world".

The next man evidently wishes to get it over quickly, for he rises promptly when his name is called: "Yentlemen, I no ban goot speechmaker, so I vill say yust about two, mebbe tree vorts. For *tjugofem* yar I haf vorked by Armour's Institute; I know you all, you all ban goot fallers, you all ban friends of mine. If there is any yustice in the vorld, you vill all mak goot. I dank you". Amid great applause the speaker sits down, quite overcome by his unexpected success.

The third speaker seems quite at home at the speaker's table, and somehow gives the impression that speechmaking has no

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SOCIETIES

ARMOUR TECH MUSICAL CLUBS

Music at Armour Institute of Technology is now an established factor in the student life, and an invariable part of every assembly of consequence. Time was when a more or less struggling glee club gave a single concert at the close of the year. There was little or no incentive for a man to report at rehearsal for weeks at a time. Few of his fellows knew of his efforts and a smaller number cared. Professor Phalen, the present director, believes however, that the musical organizations ought to serve the school in the capacity of a dignified, reputable advertising medium. With this end in view the clubs last season gave some ten or twelve concerts in and around Chicago. In every instance the programs were satisfactory and return engagements are scheduled for this season. Today the band, glee club, and orchestra are vital student activities which are receiving an ever-increasing amount of attention. The student body at assembly makes its appreciation of music very evident. There are frequent and spontaneous calls for the Fight Song, and for encores that give evidence of the new place that music has made for itself in the consciousness of the student body.

Early in the second week of school when there had been opportunity for but one rehearsal, a band of thirty pieces appeared at assembly and acquitted itself most creditably. With this as a starter the good work has continued under the able leadership of Mr. A. A. Anderson and unstinted praise has been heard on every hand.

The Armour Band was started, kept alive, and literally hammered into a worthy musical unit by the untiring efforts of Mr. W. B. Douglas, '24, who for two years gave of time, energy, and ability with a prodigality which will ever be an example of college loyalty for future students to emulate. The watch which was presented to Mr. Douglas by the student body at the close of last year was only a fitting token of the service he had rendered his Alma Mater. Mr. Anderson in assuming the baton for this year comes to the position well qualified in both experience and musical ability. As solo cornet for both band and orchestra last year he naturally worked into a position of leadership. He enjoys the confidence of his fellows and there is every reason to expect that the band will increase and improve, and occupy a larger place in the estimation of the college.

The orchestra, on account of its very nature is somewhat slow in developing. The music is not essentially more difficult than band music but it is usually less martial and on account of lesser tone volume, individual errors are more prominent. On this account fewer students feel capable. It is hoped that such an attitude will not persist and that every musician, especially violin students, will at least try for a place. Each year players testify to the fact that the time spent at rehearsal and concert has been most profitable, because of added ability in sight reading. The outlook is good. Nearly all the veterans of last year are back and there is a very noticeable influx of freshmen. By graduation we lost Douglas, double bass; Schmidt, oboe, and Samuels, first violin, but these places have all been filled and in addition there is a wholly new and very competent clarinet section. At an early date an orchestra of about twenty-four pieces will make appearance.

Mr. C. E. Tweedle, who by his own confession would "rather play than eat" is leader and will also hold down, as he did last year, the position of concert master. He is a lover of music and his faithfulness at rehearsal and attention to business cannot help react upon the other members advantageously.

The Glee Club is by far the one club that has grown out of all recognition. Last year at no time did we have ever thirty candidates; first tenors and second basses were at a premium. This year the regular attendance at rehearsal is about forty-five and the parts are distributed as follows: nine first tenors, nine second tenors, eleven baritones, and fifteen second basses. The boys are full of pep and are anxious to be in the vanguard this year at the intercollegiate contest. They are also planning to give as many concerts as possible in and around Chicago, and earnestly solicit the aid of the readers of THE ARMOUR ENGINEER in that direction. The repertoire will consist in part of the following songs: The Two Grenadiers, Come O'er the Sea, The Long Day Closes, and The World Is Waiting for the Sunrise.

ARMOUR RADIO ASSOCIATION

The officers of the Armour Radio Association for the following year are:

President.................	D. J. McFaul
Vice-President..........	A. C. Holmquist
Secretary..................	E. J. Posselt
Treasurer..................	L. F. Pfeiler
Chief Operator............	L. M. Endres

The first meeting of the Armour Radio Association was probably one of the most important as far as the operation of the radio station is concerned. Mr. McFaul outlined the plans of the association's future meetings. It may be said that the meetings are for the benefit of the general student body and that all men interested are cordially invited to attend. In order to make the meetings as entertaining as possible, formal business will not be discussed any more than necessary, and a speaker will usually be present.

For the first time in history Armour Institute of Technology can boast of a radio station in actual and continuous operation. Much work has been required to make this possible. Credit should be given all the officers and the other operators of the station.

As most students know, the plans for a station have never been fulfilled due to lack of funds and reliable apparatus. Some time ago through exceptionally good luck for our part, a complete broadcasting station was donated by W. A. Wieboldt & Co. After some time an outside single phase a-c power line was installed to run the motor generators for the plate supply of the 250 watt tubes.

At present the transmitter consists of one 250 watt tube in the Hartley circuit, supplied by 2,000 volts d-c on the plate. It is operated anywhere between 150 and 200 meters, or 75 to 80 meters can be used during silent periods. The receiver is a new low loss tuner and three step amplifier, built by Mr. McFaul and Mr. Posselt, with which it is hoped European amateurs will be heard. We know and will soon prove that the transmitter will easily reach Europe and probably New Zealand. Mr. Endres has operators for five nights of the week and the station is in operation continuously. Our old call 9YL expired some time ago and the new amateur call is 9NV. We hope that we will soon have a "Z" call which will give us many more operation privileges.

During the operating periods messages will be handled with amateurs all over the continent. College news and events of importance will also be transmitted back and forth. The association is affiliated with the American Radio Relay League and any friendly messages will gladly be handled for the students or faculty free of charge. These messages are relayed in the direction of their destination, and the amateur last receiving the message will either deliver the message in person, telephone, or mail it.

The official opening night on the schedule of operation was Monday, October 13.

ARMOUR TECH ATHLETIC ASSOCIATION

The organization of the association for the year 1924-25 has been completed. Plans for the work of the association are now maturing.

The officers and committees for the present year are as follows:

President....................	C. J. Plocar
1st Vice-President.........	S. J. McLaren
2nd Vice-President...............	C. Long
Secretary.................	D. B. Davidson
Treasurer.................	G. S. Allison
Chairman of Social Committee......	E. S. Larson
Chairman of Publicity Committee....	V. D. Taylor
Chairman of Reception Committee...	E. J. Harrington
Inter-Class Athletic Manager...	S. Owens
Inter-Fraternity Athletic Manager...	C. G. Miller
Freshman Representative...	M. B. Tracy

AMERICAN INSTITUTE OF CHEMICAL ENGINEERS

Armour Branch, A. I. Ch. E. held its first meeting on September 10. The meeting was devoted to election of officers for 1924-25. The officers elected were:

President....................	I. A. Deutch
Vice-President................	J. S. Perry
Treasurer....................	L. E. Kraus
Secretary..........	E. A. Armit

At the following meeting, October 9, Professor Harry McCormack gave an instructive address. His subject was: "Opportunities for Chemical Engineers."

Mr. William Hoskins, of Mariner and Hoskins, addressed the society on October 16, his topic being, "The Outlook for Chemists and Engineers".

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ATHLETICS

OUR ATHLETIC PROGRAM

Our athletic program started early this fall with a tennis tournament, a golf tournament, the Freshman-Sophomore track meet and inter-class basketball. All this has been due to the efforts and co-operation of the Armour Tech Athletic Association, Athletic Director John Schommer and the coaches of the various teams. The Athletic Association and Athletic Director Schommer have retained the Eighth Regiment Armory at Thirty-fifth Street and Giles Avenue for our basketball practice and games. We have been very fortunate in obtaining this large floor because in previous years some teams have refused to play us due to the smallness of our own gymnasium. We will have the use of the Armory for three nights a week during the months of November, December, January and February, and this is at a lesser cost than two years ago at which time we were permitted to use the floor two nights a week for the first three months mentioned above.

Swimming arrangements have been made under practically the same terms as last year except that we will have a new coach to take the place of the late "Doc" White, the well known and well loved coach of Chicago University who passed away last winter.

With the impetus which has been given to athletics this season, we must keep up the good work by backing all the teams. We want everybody out for some sport even if we have to organize a "barnyard" golf team to help matters out. Back your class teams if you can't play on them. Come out for wrestling and swimming, basketball and boxing, and by so doing you not only put yourself in better physical condition, but you also help to better school spirit. Remember we have no freshman rule in the Institute and so freshmen are eligible to all varsity teams.

Last year we were very fortunate in securing for our coach the famous U. of C. basketball star, Milton Romney. Our team made a very good showing during the year. This year, with the same coach, we will expect even better results. As a nucleus Romney has ex-captain, Joey McLaren our w. k. basket-shooter; Gaylord, Brockman, Busche, Peterson, Kuffel and Osgood, all of last year's squad. Besides this powerful aggregation we will surely uncover some good material from our vast, green, unexploited freshman class. Although our schedule last year embraced many opponents out of our class, we hope this year to be able to take their measure on the floor. The basketball schedule is being completed by Manager Louis S. Green, '25, and we are going to have some real games. So let's all get together and come out to every game so that the team will get all the support we can give it.

Coach Phalen will direct the track and cross-country teams again this year after a very successful season last year, which will, from all indications, be duplicated next spring.

Wrestling and boxing will be under the guidance of Coach Smith whose teams met with marked success last season.

Swimming will be coached by McGillivray, brother of the famous "Perry" of I. A. C. fame. The University of Chicago tank will be at our disposal during the season for the members of the team. For this arrangement we are greatly indebted to the U. of C. and Athletic Director A. A. Stagg. Practice will probably be arranged for by special agreement between the individual swimmers and Coach McGillivray. Last year's team will again be out in full force, having lost only one man through graduation, and we expect great things from Marhoefer, captain elect for this season; Brown, Schuler, DeBourge and others, in this, our second season of swimming.

Coach Leigh will again take charge of our golf team which went through last season without a defeat.

Tennis will be under the able direction of Professor Tibbals who in the past has been unfortunate in having his teams beaten by the well-known graduation. This year, however, most of the men remained with him and in addition one of the members of the original "first tennis team" is back in the harness.

Coach Penn will have practically the whole baseball team of last year to work with Captain Laurie Burke, Plocar, Downes, McLaren, Geiger, Schone, Ruzick, Harrower, and Hofer back in school. Bill Desmond, captain of the '23 team will be playing again this year after a year's absence from the diamond. Due to a dearth of pitchers, last season was unsuccessful. We will need at least a half a dozen hurlers next spring so all you ex-high school stars get up in the gym and start limbering up. Also bring all the prospects in sight, up to work out with you.

TRACK

Any prognostication made at the present concerning the track work of 1924-25 must of necessity be premature. It is safe to say, however, that in spite of the loss by graduation of our most sterling performer, Captain, O. M. Spaid, the coming season will be a success.

Captain L. R. Hoff, a runner of ability and long experience, has the confidence of his team-mates and is in every way capable of leading his men to victory.

There are ten "A" men of at least one season's experience who are sufficiently diverse in ability to insure that all the events will be cared for in a creditable manner.

The Freshman-Sophomore meet on October 3 is reported in detail below. The outstanding feature was the large number of entries in the several events. We trust this is an omen of a track squad of fifty men in the spring.

The following men placed in the meet:

Sophomores	Freshmen
Long	Hamlet
Ball	Tracy
Payne	Samuelson
Harrower	Phelan
Price	Jillson
Alexander	Shaw
Hefner	Kreiback
Morgan	Knudsen
Davis	Eichin
	Ogden

The cross-country team under the combined efforts of Coach Phalen and Captain O. L. Robinson is grinding into shape and will give a good report of itself when the crucial races arrive. Sixteen men are reporting for training which is more than twice as many as last year. This shows a healthy increase in an athletic activity which is very vital to the success of the spring season, namely, the training of distance runners. Meets have been arranged with Northwestern College, Wheaton College, and Y. M. C. A. College.

GOLF

The Golf Team of 1924 had a very satisfactory season. Six games were played with teams from De Paul, Columbia College, and Crane Junior College. Not a team match was lost. The letter men on the team were Dunlop, Captain Miller, Urban, Schroeder, and Peterson. Neither Dunlop, Miller, nor Urban were defeated by an opponent during the season. Urban had a record of winning fourteen out of a possible fifteen points, being tied for one point because of a lost ball. Urban also won low qualifying medal at Dubuque in a triangular tournament.

This fall we have a tournament in progress. The results thus far have not shown any new men capable of displacing any of the regulars. All of last year's men are back except Schroeder.

Freshman-Sophomore Track Meet

Sophomores—72 Freshman—50

	Places			
Events	1st	2nd	3rd	Time
100-yd. Dash	Long	Hamlet	Tracy	:11
220-yd. Dash	Long	Hamlet	Tracy	:24
440-yd. Run	Samuelson	Ball	Long	:58.4
880-yd. Run	Samuelson	Ball	Payne	2:15.2
Mile Run	Ball	Payne	Phelan	5:31.4
2-Mile Run	Payne	Ball	Harrower	13:38.2
100-yd. L. Hurdles	Jillson	Price	Shaw	:12.4
Discus	Alexander	Hamlet	Hefner	87′ 0″
Shot	Hefner	Hamlet	Kreiback	29′ 4″
Javelin	Alexander	Hamlet	Hefner	120′ 11″
Pole Vault	Morgan	Harrower	Eichin	8′ 4″
High Jump	Hamlet Knudsen	Tie	Ogden	5′ 1½″
Broad Jump	Morgan	Davis	Long	18′ 2″
Relay	Freshman—Tracy, Knudsen, Samuelson, Hamlet			1:08

High point man—Hamlet, 19 points

FRATERNITIES

SOMETHING ABOUT TAU BETA PI

Tau Beta Pi is the National Honorary Engineering Association. It has chapters in the leading engineering colleges in the country, the chapter at Armour Institute of Technology being Beta of Illinois. The insignia of the association is the Tau Beta Pi key or "Bent".

Elections to membership to Tau Beta Pi are held bi-annually—in the spring and in the fall. In the spring those Juniors who come within the highest one-eighth of the class, scholastically, are eligible. In the fall elections those men in the highest one-quarter of the Senior class, together with the Junior having the highest average in his class, are eligible to election. The qualities of character, loyalty, personality, and school activity, which mark the finished man, determine the worthiness of a man to wear the "Bent". At a meeting held October 14, six Seniors were chosen to wear the white and brown pledge button of Tau Beta Pi, they are:

A. A. Anderson
R. L. Lawson
E. S. Larson
E. W. Odenwaldt
W. H. Sothen
C. M. Rowley

The National Convention of Tau Beta Pi was held at Ames, Iowa, October 16, 17, and 18. Brother Meyer represented Beta of Illinois, and reported a live convention. The delegates on their way to Ames stopped over at Chicago on the fifteenth and were shown the sights by the local chapter.

The present officers of Beta Chapter are as follows:

President....................M. F. Adair
Vice-President..........A. L. Stemwedel
Corresponding Secretary......H. J. Luth
Recording Secretary........E. M. Meyer
Treasurer..................S. R. Willey
Associate Editor of "The Bent".....
..................H. W. Regensburger

ETA KAPPA NU NOTES

September has come again, and with it the reunion of the old gang after the arduous duties of the summer vacation. Now, after a couple of weeks in the old familiar haunts we are deep in the mysteries of A-C, determined to hit it harder than ever and keep Eta Kappa Nu at the high point of previous years. We are looking forward to many pleasant times together, and extend a hearty welcome to the graduates to drop in on us and renew old acquaintances.

At the last meeting of May, the following men were chosen to fill the chapter offices:

President..............A. L. Stemwedel
Vice-President................C. J. Buck
Treasurer:..................E. M. Meyer
Recording Secretary.........H. H. Chun
Corresponding Secretary....E. S. Larson
Associate Editor of the Bridge......
......................W. J. Patterson

The middle of July found the bunch half way around the world. Brother Chun was basking beneath the mellow moon of Hawaii, while Brother Klein, '24, was gazing on the splendors of ancient Rome, and our own Bill Sothen was personally investigating the claims of cool Colorado. The less fortunate brothers were busy with the problems of the Surface Lines, Commonwealth Edison, and Bell Telephone.

We are sorry to announce that Brother Stryker has found his business relations with the Fansteel Products Company, at North Chicago, make it necessary for him to sever his connection with the Armour Institute of Technology. We wish Brother Stryker the best of luck in his new field of endeavor. However, we are glad to announce that Brother Richardson, '24, has been selected to fill his place. His classes are extending over time, which ought to be a good indication of how well he is presenting Sophomore electricity.

The National Convention was held at Urbana, Illinois, on October 23 and 24. Brother Stemwedel represented Delta Chapter. Some very live issues were brought up at the convention and satisfactorily handled.

PHI LAMBDA UPSILON

Phi Lambda Upsilon, honorary chemical society, enters the present year with the following officers:

President....................M. F. Adair
Vice-President..............T. Bockman
Treasurer..................R. E. Dufour
Secretary..................I. A. Deutch

At the pledge smoker held October 30, the following men received the red and blue badge:

SENIORS

L. E. Kraus
H. J. Luth
W. H. Weinwurm

JUNIORS

J. S. Perry
B. H. Schenk

Our pledge smoker was well attended by alumni members of Phi Lambda Upsilon living in Chicago. With the pledges serving as a prospective nucleus for the chapter we anticipate an active season.

CHI EPSILON

The Armour chapter of Chi Epsilon enters the year with three active members:

President..................S. R. Willey
Vice-President and Treasurer........
........................E. L. Gritschke
Secretary................R. L. Lawson

Our first meeting was held September 27, at which time the work accomplished at the National Convention, held in Chicago last July, was discussed. This convention was all important as it was the first ever held, Chi Epsilon being a new fraternity. S. R. Willey was the Armour chapter delegate and he deserves much credit for his work in helping solve the many problems that came up.

We are now well represented in the National Governing Body, three of its members being graduates of Armour Institute of Technology, namely, C. W. Carlson, '23, Grand Secretary; H. W. Munday, '23, Editor of the "Transit"; and M. G. Burkey, '24, member of the Supreme Council.

SCARAB

Since our organization last graced these pages, great things have happened. Last semester, on the evening of April 25, 1924, faithful Scarabs journeyed to the City Club for the annual initiation banquet. Seven potential architects and one famous sculptor were introduced into the many mysteries of the desert. Mr. Emil Robert Zettler, instructor in Architectural Modeling, was installed as an honorary member. Albert Bacci, Earl Busch, Ralph Emerson, Paul McCurry, Edwin Peterson, Will Ralph, and David Scoville were the initiates.

Several very inspiring talks by Mr. Marks and Mr. Zettler, as well as the attendance of many of our alumni added to the enjoyment of the evening.

Karnak Temple, at the University of Illinois, will be host to the annual Scarab convention, the latter part of October.

SALAMANDER

We are pleased to announce the initiation of Professor O. L. Robinson as an honorary member, and A. K. Miller, and S. J. McLaren, Jr., as active members, April 29, 1924.

The last big meeting of the year was held on May 15, and the election of officers for the ensuing year held. As nine of the brothers were to graduate in a few days, the remainder of the meeting was turned into an informal farewell smoker.

In October the fall election to Salamander was held, adding to the group who have already earned the right to wear the key of Salamander, a right well worth working for.

PHI KAPPA SIGMA

With a nucleus of eighteen men, and a dozen men from one of the best Freshman classes that has ever entered the institute, the Alpha Epsilon chapter of Phi Kappa Sigma is entering upon this college year with the greatest enthusiasm.

The college year began officially with a house-cleaning party, which was participated in with evident enjoyment by the entire active chapter. After the last particle of dirt had been removed, paint was applied freely, the result being a distinct triumph for engineering education. New furniture has added considerably to the atmosphere of the place and makes a fitting background for the social events to come.

Rushing under the new system did not commence until September 29, but during the brief rushing season Alpha Epsilon played host to a select group of Freshmen at a smoker, football game, theater party, and a dancing party, all of which were real events.

The Alpha Epsilon chapter of Phi Kappa Sigma wishes the incoming class of Freshmen an enjoyable and inspiring four years of college work.

THETA XI

On the fourth day before registration all the active members gathered at the house to prepare for their second year in our own home. Starting at the top and working down, it was not long until the house was again ready for occupancy. Our annual Homecoming and Housewarming function was held Saturday, October 18, and attended as it was by over one hundred alumni, turned out to be even a greater success than that of last year. The house was open from noon until midnight and every man that signed the register expressed his reluctance to depart.

October 12, at the zero hour, fourteen men that had chosen Theta Xi were pledged. They are as follows: Bayes, Boston, Henry, Higgins, Horn, Hougen, Johnson, Kreibich, Linder, Ogden, Parker, Patterson, Rose and Shaw.

This marks the culmination of a rushing season of distinctive parties, such as our dinner dance given at the new Southmoor Hotel, and attended by forty couples. The usual house dance was held October 10, and we danced to the ragtime tunes of Hank Harris and his Harmonizers. Our smoker of October 12 was enlivened by some songs from a hybrid quartet. The songs they sang were wonderful selections, but the rendition, to put it mildly, was terrible.

We have the honor of holding two captainships in the house this year. Brother Robinson, captain of the Cross Country team, and Brother Dunlap, captain of the Golf team.

We have been further honored by the visit of Dean and Mrs. L. C. Monin and Dr. and Mrs. Oscar Linder for dinner. We always enjoy these visits and wish that they could be more frequent.

The annual Hallowe'en festival was held November 1 and exceeded all expectations for good times and surprises. Each year the Hallowe'en party becomes more firmly established as an institution and the good time is proportional to the number of years that it has been held.

TRIANGLE

After a strenuous vacation, Triangle men came drifting back full of the old "wim, wigor, and witality" ready to start quantity production on experiment reports. Our actives were nineteen strong and with a gang of able pledges Triangle is looking forward to a great year, well balanced with social activities.

The official season opened with a smoker on October 1, followed by a house dance on the following Saturday. And oh! boy wasn't it a riot? Some of our guests from the University of Missouri missed their train and didn't care. During the second week of rushing we were hosts to a very promising group of freshmen at a theater party and a smoker, both of which furnished genuine entertainment.

The Armour chapter of Triangle extends a most hearty welcome to the incoming Freshman Class and wishes them a very successful college career.

SIGMA KAPPA DELTA

Our men have returned from their summer vacations and each told his respective story. Some tried to convince us that they had been working industriously for a living during the last three months, while others owned up to the good times they had been enjoying. But that is all past history, and we are now all plugging along at our books again.

Our social activities offer bright spots for everyone in the fraternity. A dance on October 4 was the first event of the kind for the year. It was given for the freshmen who had been especially invited. They were many in number and all danced their heads off to the peppy music furnished by the Fisk orchestra. The active chapter members also joined in enthusiastically to start the hall rolling. Following this was the smoker where all the new men and alumni were entertained in various ways, one being our ten-piece jazz band. It was a most agreeable evening. On November first we held our Hallowe'en party and dance.

We have the honor to announce the pledging of the following men: Heine, Schram, Schoenwolf, Tater, Knudson, Andrews, Tracey, and Webber.

PHI PI PHI

The first two months of the college year have been busy ones for Gamma chapter of Phi Pi Phi The opening day of college found the bunch all back and full of enthusiasm and pep.

The first social event of the season was the annual fall dance held at the chapter house on Saturday evening, October 4. Benson's Collegians presided and their music was every bit as good as on previous engagements. Among those of the alumni present were, Gerry Schumacher, Norm Olson, Roy Goppelsroeder, and Rudy Lowe. The first smoker of the year was held on the following Wednesday and was a great success from all angles. A number of the boys journeyed out to Northwestern University on the following Saturday to view the Northwestern-Cincinnati grid battle.

On Sunday evening, October 12, a theater party was held at the La Salle Theater, which was attended by the greater proportion of the chapter and provided a very pleasant evening.

Gamma chapter at this time wishes to announce the pledging of the following men:

R. N. Brown
L. J. Marhoefer
H. J. Burke
G. J. Jennings
R. N. McFerran
K. C. Anderson
T. Samuelson

BETA PSI

Some of our fellow students were surprised to hear that a new fraternity had been organized at Armour. Many questions were asked of the boys who displayed the new pins. The foundation of Beta Psi was laid in the spring of 1923 when a group of students formed a club which was known as Sodales. Since that time our plans were gradually realized. Last August the Beta Psi National Fraternity was incorporated.

The Alpha chapter of the fraternity is at the University of Illinois, while Armour organization is known as Beta chapter. As yet we are without permanent quarters, but in due time we hope to move into our home.

RHO DELTA RHO

Rho Delta Rho moved into its home on September 8, with extremely high hopes of this being the banner year of its history.

Our first event was the annual "Welcome Home", held the Friday after school opened, followed by a smoker on October 3, to inaugurate the rushing period. Both affairs were unique in that our alumni turned out in full force.

Graduation diminished our active list appreciably, the lucky men being, Roswick, Baim, Parker, Goddman, Walk, and Brostoff. Incidentally, one of the above named will soon announce that Mr. and Mrs. ——— will be at home.

SIGMA ALPHA MU

With spirit and bright hopes for the most successful year of our existence, the group of Sigma Epsilon welcomes the return of the scholastic season. Far from being inactive during the warm days, many frequent gatherings, numbering among them a smoker and two dances with a general get-together affair to wind up the swiftly passing summer were held. Plans for a smoker, and Hallowe'en dance at our new and pleasingly furnished home will start us off again for the first semester.

WE HAVE WITH US TONIGHT:

(Continued from page 22)

terrors for him. "Not since Dominion Day in Kingston have I seen so much enthusiasm as has been shown here tonight. That former date is well marked in my memory for it was then that I received the long-service medal, emblematic of fifty years' continuous service in the regimental band of the Northwest Mounted Police. Now I have finished twenty-five years in the chemical *labitry* of A. I. T., and this occasion tonight seems, to me at least, commemorative of that quarter century in chemistry. The years seem to pass rapidly now and soon the fourth quarter century of my career will roll by, and then the hardest part will be over. I see many familiar faces before me, and I want to number all of you among my friends. Sometimes in your student days I may have seemed rather severe; sometimes you asked for platinum and I gave you porcelain, or for "C. P.", and I gave you "commercial". But those little differences are all in the past and in the perspective of the years they seem very insignificant. I wish you all a full measure of success."

The fourth man is younger than the others, but he seems to know almost all the men in the room, especially the more recent graduates. "I am surprised and pleased to see so many of you here tonight. When I think of all the flunk notices which I have sent out I am surprised that so many of you made your peace with the professors and succeeded in graduating. You understand, of course, that all those flunk notices didn't originate with me; otherwise I would have very few friends among you. I was only the sending station from which the faculty were accustomed to broadcast their opinions of the student body. I am glad that so many of you got by, and doubly glad to see you here tonight."

As the affair breaks up, and the men make their way to the elevators, it is declared the most successful, as well as the largest gathering, in the history of Armour Tech Alumni Association. The "eats" good, the program of contests amusing and diverting, "Prexy" Raymond and Dean Monin instructive and inspiring, and the four guests, men who make the wheels go, supplied an entirely new note in such affairs.

ENGINEERING NEWS

A Stadium for All Chicago

Grant Park is regarded by all Chicago as its Place of Pageants. Whether it be a municipal Christmas tree or the Victory Way, a Pershing parade, or a military review, there is no question as to the scene. Naturally, if important, the event is staged in Grant Park and the city is satisfied. Quite reasonably then, the city was pleased when it was announced that the South Park Commissioners, under whose direction Grant Park is maintained, had determined to build a stadium there in which vast crowds could be accommodated.

The commissioners quietly held a competition in which several of the larger firms of Chicago architects took part. As a result of the decision of the Jury of Award, the design of Holabird and Roche was given premier honors, and the commissioners announced that eventually these plans would be carried out in an area just south of the New Field Museum.

From the moment that Grant Park was selected as the location for the new Field Museum, the architecture of future structures was determined. So in this plan for a stadium the architects developed a design which is in complete harmony with the Museum, and in fact consider it as the head of the composition, the axis of the Stadium being the same as that of the Museum. So, too, the north end of the arena is left entirely open, affording to each spectator an unobstructed view of the Museum. This factor was in truth one of the two fundamental requirements in the solution of the problem in the winning design. The other basic necessity was one of construction, being that the majority of the permanent seats should be concentrated around a comparatively small area to afford to the greatest number the best view of those events which could not fill the Stadium to capacity.

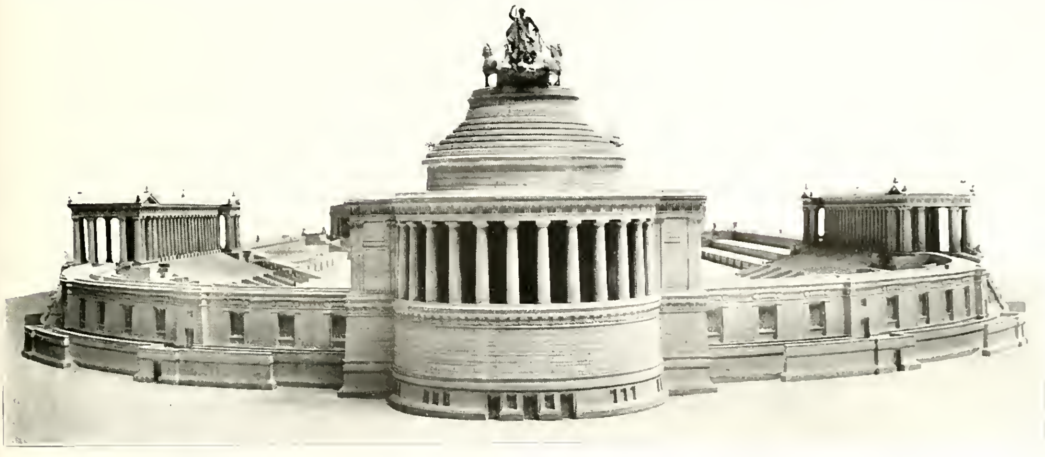
Mr. Martin A. Ryerson was chairman of the Jury of Award, the members of which were Mr. Richard E. Schmidt, of Schmidt, Garden, and Martin, architects; Mr. Pierce Anderson of Graham, Anderson, Probst, and White, architects; Mr. A. A. Stagg, Athletic Director of the University of Chicago; and Mr. J. S. Foster, Superintendent of the South Park Commission. Thus were the plans subjected not only to able critics architecturally, but to practical men accustomed to the handling of crowds, and to the staging of events such as those which logically will be held in the Stadium.

Immediately to the south of the Field Museum is an esplanade, and the structure in the north sector is merely a series of terraces leading from the esplanade and finishing opposite the end pavilions of the Museum in simple sculptured walls and stairways. The permanent seats on the north are entirely below the grade of the esplanade, and by reason of this treatment, the north end of the Stadium entirely avoids a conflict with the architecture of the Field Museum.

In the solution of the second paramount requirement in the problem, that of seating, the width of the arena is made as small as is practical, being only three hundred feet between walls. The east and west stands, the important ones in this solution, are made higher than the north section to give a larger number of seats in the central part of the Stadium. These stands are marked by porticoes, and a football field is placed on their center-line. The finish of a quarter-mile running track, and of a two hundred and twenty yard straightaway, is opposite the reviewing platform at the center of the west stand. These two stands combined with theater seats on the semi-circular south end comprise the large majority of permanent seats, and all are of nearly equal value for most of the events and displays that will be presented in the arena. It was necessary to extend the height of the stand around the small, central area to a grade above that of the esplanade at the north. This is justified by the designers, first, because it gives the spectators a better view of all the details of events held in the arena; secondly, because the arrangement permits the north sector to be kept at a low elevation. The sections show that the circuit of the amphitheater is slightly bowled in order to give the proper lines of sight, and at the same time to keep the stands as low as possible.

The sixty-thousand permanent seating capacity includes the main east and west stands, full height, the theater to the south, except the upper terraces, and the section in the north below the esplanade grade. An additional forty-thousand temporary seating capacity is provided for by the use of the upper theater terrace, the three terraces north of the main east and west stands, and a portion of the north end of the arena. The full one hundred thousand seats surround the whole Stadium uniformly. The terraces thus form bases for temporary seats, and under this arrangement the seating becomes especially flexible, as any number of terraces may be filled with temporary seats, leaving a finished structure in the event that they are not all covered. The terraces also have the advantage of serving as promenades for the spectators and sightseers. A promenade at the grade of the esplanade extends entirely around the Stadium. From it, at suitable intervals, extend passageways and ramps leading to the banks of seats. People may enter at the north end on this level, or any of the terrace levels, and proceed to the section they are seeking. Entrances are provided at suitable intervals along the exterior of the Stadium. These lead through the structure, and, by tunnels and ramps, to the various banks of seats. Direct access to the upper promenade is furnished by stairways. In addition, all main aisles in the amphitheater lead directly to the arena, where egress is furnished by the entire north end, or by passage south of the main east and west stands.

Pageants and large bodies of troops would enter from the north, pass south by the west reviewing stand, circle the theater with its reviewing stand, and then move north and out again. In this



The theater of the Chicago Stadium, in the immediate foreground, remains to be constructed.

way there would be no limit to the number of troops or the size of pageants.

The space under the main east and west stands, and under the theater has been left free from columns. This is divided into three large halls having approximately 125,000 square feet of floor space available for large automobile, live stock, dairy, industrial, and educational exhibitions.

Courtesy of Col. H. B. Hackett.

Michael Pupin Writes an Autobiography

A book of real inspiration to the student striving for fame and wealth in the field of engineering and of science is the book, "From Immigrant to Inventor", an autobiography by Michael Pupin, noted scientist and engineer, and at present Professor of Electro-mechanics at Columbia University. Pupin's story of his early struggles should prove heartening to all of us, for, overcoming as he did the countless obstacles and disadvantages confronting a Serbian peasant immigrant boy in a strange land, a boy, used to the life of a shepherd in a peaceful and sleepy Serbian village, and cast into the midst of bustling, heartless New York where no one spoke his tongue, he faced and conquered difficulties that very few of us have to overcome.

Throughout all his work Pupin has always endeavored to bring the complex down to the simple, to make the invisible and mystifying electrical phenomena harmonize and fit in with the visible, everyday physical phenomena. He appreciated the fact that electricity has inertia and can acquire momentum just as any particle of matter, and the oscillations in an electric circuit may be compared to the oscillations of a tuning fork or pendulum due to its inertia and acquired momentum. During his work with oscillatory circuits he developed the resonance "tuning" system, which is in use in millions of radio receivers and transmitters today. This system changes the frequency of the electrical vibrations by changing the inertia of the electrical circuit just as the frequency of the tuning fork may be changed by changing the inertia of its moving system.

Dr. Pupin's invention of the loading coil for long distance telephone transmission, the patent rights of which he sold to the American Telephone and Telegraph Company, was the grandest triumph in his application of pure mechanics to the electric circuit, and was an achievement which won him fame on two continents as a consulting engineer in telephony. He knew that a wave of energy may be made to travel along a stretched cord by shaking it at one end. By loading the cord with small weights at evenly spaced intervals, i. e., supplying the cord with distributed inertia, waves could be produced with greater ease. Children may often be seen shaking a jump rope to produce standing waves in it, not knowing that they are utilizing the inertia of the segments of the rope and their ability to acquire momentum. Pupin carried this simple principle right over to the electric circuit, and argued that a transmission line may be made a much better passage for waves of electrical energy if it was supplied with distributed inertia, or distributed self inductance, as it is called in electrical terms. In other words if the transmission line could be given a natural period so that it would more nearly be in synchronism with the waves of electric energy passing through it, these waves could be sent much longer distances with diminished losses. Thus, just as the cord might be loaded with small weights, the telephone line is loaded at evenly spaced points along its length with self inductances or "loading" coils, for many years called "Pupin coils" in honor of their inventor.

The autobiography of Michael Pupin is not merely a history of the achievement of one man, but becomes so broad in its scope as to constitute a real treatise on the wonders of natural philosophy. It has no mathematical figures and formulae, but it prepares the mind of the average man to really understand physics far better than any text book of physics can help him; it lifts back the curtain and gives him a vision of the phenomena of nature and its mysteries which cannot yet be explained, and shows him the seemingly endless problems yet before the scientist; in a word it takes him over the mountains which have hitherto been obstructing his view and shows him the green valleys stretching beyond to the horizon which no man has yet attained.

SOCIETIES

(Continued from page 23)

FIRE PROTECTION ENGINEERING SOCIETY

The first meeting for the year 1924-25 of the Fire Protection Engineering Society was held October 2. Meetings are held regularly every first and third Thursday of the month. At the first meeting Professor Finnegan addressed the society, formulating the activities of the coming year and acquainting the freshman members with the purpose of the organization.

It has always been, and will be the practice of the society this year, to have eminent speakers give talks on subjects pertaining to the work of the members. On October 16, Chief Arthur R. Seyferlich spoke on the subject of Fire Fighting in the City of Chicago, an extremely instructive subject. The second speaker, Mr. E. W. Hotchkin, class of 1910, addressed the members on the subject of Fire Insurance Underwriting. Mr. Hotchkin is the Assistant Secretary of the Continental Fire Insurance Company. His address was very comprehensive and worth a great deal to all who heard him.

The year's schedule of events includes two smokers; don't miss these, you will regret it if you do.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS

After the first meeting was adjourned, there was no doubt in anyone's mind that the coming year would prove a banner one for the Armour Branch of the A. I. E. E. There were forty-five men at the first meeting, very near all of them being members. The Junior Electricals were one hundred per cent in enrollment. This opportunity is taken to congratulate them on their splendid turnout and promptness in paying dues.

The meetings will be held the first and third Thursdays of each month. The first meeting was given over to a speaker of prominence who talked on a subject that was chosen by a majority of the members.

In the past we have always had an excellent showing at meetings that were addressed by outsiders. This was probably due to the high ranking engineers that were secured for the occasions. The attendance to meetings at which students were to speak was not as high as it should have been. The reason for this in many cases was that the students had chosen uninteresting subjects for their speeches. This fault has been remedied in the following way: a committee composed of three faculty members has been elected, the purpose being to help the students prepare their talks. All members wishing to speak will present their subject to the committee. Undesirable subjects will be weeded out before any time has been wasted upon them. Help and suggestions will be given to the members presenting suitable subjects. The committee will also call upon many of the students whom it knows have had sufficient experience to give a good talk on these experiences.

Arrangements have been made so that all the members will be instructed in the Pullman pressure method of restoring respiration to those succumbed to electric shock. Watch for the annual smoker and come out and see what a lot of live wires we have in the organization.

Officers for the organization for the year 1924-25 are:

President..................A. Stemwedel
Treasurer....................H. H. Chun
Secretary...............Wm. H. Sothen

WESTERN SOCIETY OF ENGINEERS

On Thursday, October 2, the Armour Branch of the Society held the initial meeting of what promises to be a most successful year. The first business was an election to fill several vacancies in office. After a close contest the following men were elected:

Assistant Secretary..........E. F. Webb
Student Representative....R. E. Ostland

Business being dispensed with, the main purpose of this meeting was brought forth in the form of talks by Professor Phillips and Professor Wells, our faculty representative. These talks, both excellent, were very emphatic in their demand for a closer acquaintance among the members of the student body and urged that every one attend the meetings of the society to be held in the future. The business men who speak to us at the meetings receive no compensation, and the least we can do is to turn out en masse and show our appreciation.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS

A regular meeting of the Armour Branch of A. S. M. E. was held May 1, 1924. The purpose of this meeting was the election of officers for the coming year. Those who were elected are as follows:

President...........H. W. Regensburger
Vice-President.............J. Schumacker
Secretary.......................G. Maffit
Treasurer......................C. Rowley

We are contemplating spending a considerable amount of our time during the semester in the presentation of illustrated lectures. Professor Gebhardt, head of the Department of Mechanical Engineering, recommended to the society that the type of meetings most suitable to the development of the members would be those in which they would have the opportunity of addressing their co-workers.

MODERN SEWAGE TREATMENT
in
THE SANITARY DISTRICT OF CHICAGO

(Continued from page 12)

with the ridge-and-furrow type at our Corn Products Testing Station for more than a year and found that it was decidedly superior. The plate ratio required is only 1:12 or 1:15 as compared with the 1:6 in the ridge-and-furrow type, thus making quite a saving in cost of plates. The air required was reduced approximately 30 per cent, resulting in a tremendous saving in operating expense. We have adopted this type of design for our North Side Plant and it is estimated that the saving in power consumption will amount to $130,000 annually.

We have tried out many types of aeration tanks, seeking to improve the circulation type. Most of these schemes attempt to use some method of circulation by mechanical means, such as paddle-wheels, propellers or turbines, with or without additional air. It has been found that it is possible to achieve activation by beating or churning air into the sewage with indications that the power required may be less than that required for air compression. Most of these mechanical schemes have originated in England, notably at Sheffield, Bury, and Birmingham, but as yet they are in the experimental stage. The design of such circulators must be relatively simple when it is realized that they must be installed in acres of tanks, probably 15 feet deep, and that they must keep millions of gallons of sewage in continuous violent agitation. The Sanitary District is now testing out three mechanical schemes and we are always ready to try some new idea, providing it has some reasonable hope of improving our present design. A year's operation of any scheme is necessary in order to accept it or reject it definitely.

Sludge Filtration

We have also spent much time and money in investigating the other difficulty of the activated sludge process—the filtration of the sludge. When the Des Plaines Plant was put in operation in September, 1922, two types of presses were installed, which were considered the best available at that time. One was a 120-plate Simplex press, a typical recessed-plate press with a special type of grooved recesses. The other was a Worthington platen press, containing eighteen bags, each 5 by 8 feet, supported between perforated platens. After filling, the bags were squeezed until a cake was formed, which was dumped by opening the lower edges of the bags by means of a toggle-joint. Both these presses proved to be unsatisfactory and have been replaced by a new type of press developed by Berrigan. This is a modification of a horizontal hydraulic press, and contains more than twice as much filter cloth as was used in the old Worthington press, enabling us to reduce the labor cost considerably. The press has many desirable features such as cheapness, a satisfactory method of filling and sealing, and the production of a cake of uniform moisture content (the cake from the Simplex press was soft near the feed channel), but the rate of filtration per sq. ft. of cloth is quite low. We are still testing out this press and hope we may be able to increase the rate sufficiently to consider the press equal to the Oliver Filter we have installed at the Calumet Plant. The Oliver Filter is a vacuum-drum filter, covered with cotton twill filter cloth, which revolves once in from 10 to 15 minutes, dipping into a reservoir of wet sludge containing 98 per cent moisture. The solids are picked up by the 20 inches of vacuum on the cloth and the cake is dried as the drum revolves. After half a revolution the vacuum is cut off by valves and slight air pressure turned on, which blows off the cake, usually about three-sixteenths or one-quarter of an inch in thickness and containing 80 per cent moisture. In reducing from 98 to 80 per cent moisture the weight of sludge has been reduced from, say 2,000 pounds to 200 pounds, getting rid of 1,800 pounds of water in this process. It is obviously desirable to concentrate the sludge by some filtration method instead of attempting to dry the 98 per cent sludge by heat. The 80 per cent cake can be dried to less than 10 per cent moisture by rotary dryers, without excessive cost, although the drying apparatus that has been used up to date is not all that could be desired. The evaporation ratio is low, only 4 pounds of water per pound of coal, about 50 per cent of what we should get, and the partially-dried sludge forms balls which are crusted on the outside and soft within. Improvements in drying procedure will come through better methods of feeding sludge into the dryer, and better control of heat application.

The real problem is still in the filtration of the sludge, as this is the most expensive part of sludge treatment. There are few chemical processes in which such a watery sludge as activated sludge must be filtered, and practically none in which the moisture is retained so tenaciously. The moisture content cannot be lowered by settling or concentrating in deep tanks as the sludge is so near a specific gravity of water that very little thickening effect is noticeable. After 12 or 15 hours the sludge turns septic and the production of gas bubbles buoys it up. Septic sludge is even more difficult to filter than fresh sludge. The only hope of getting good rates of filtration depends upon proper pretreatment of sludge. This was realized six or seven years ago, and since that time a tremendous amount of research has been carried out on sludge treatment.

Experimental work at the Stockyards Testing Station in 1917 indicated that acidification of sludge gave considerably greater rates of filtration than could be obtained from the untreated sludge, which is practically always slightly alkaline. Subsequent work by Wilson and Copeland at Milwaukee indicated that the degree of acidification could be controlled most easily by hydrogen-ion determinations, and further, that heating after acidification would increase the rate greatly above that obtained by acidification alone. Wilson also added filter alum to the hot, acidified sludge and found that the rate could be increased still further. He worked out a very complete theoretical explanation based on facts of colloid chemistry. The high rates of filtration obtained by him (0.020 to 0.030 pounds of dry sludge per square foot of filter cloth per minute) depend upon very accurate control of the PH and a considerable degree of heat (160 F.). If the acidity is not just right the increase in filtering rate is not commensurate with the cost of acid, and in all cases the expense of heating sludge containing 98 per cent water is considerable. Experimental work in the laboratories at our Des Plaines and Calumet Plants have not shown such increase in rates by heating, but have indicated that alum used in the cold is more satisfactory than acid, from the standpoint of rates of filtration as well as ease of control. No accurate adjustment of reaction is necessary and the expense is probably no greater than if acid were used. For example, the following results in Table II were obtained on Calumet sludge.

(Continued on page 30)

MODERN SEWAGE TREATMENT

(*Continued from page 29*)

These tests were run with unheated sludge, but heating the sludge did not give much better results—in fact not as short a time of filtration as could be obtained with alum and cold sludge.

In consequence of the satisfactory results we have obtained by the use of alum we have used it uniformly at both the Calumet and Des Plaines Works for sludge treatment. Experimentally we have tried the effect of many other filter aids, such as phosphates, bone ash, Filter-cel, and sulphur dioxide, but have found none of them as satisfactory as alum. We do not feel, however, that the possibilities are exhausted, and hope that some cheaper method of dewatering sludge may be developed in the next few years. We have not planned to dry the activated sludge from our North Side Plant, which is to be completed in 1927 or 1928. We expect to pump the sludge into abandoned quarries southwest of Chicago unless some cheaper process of dewatering is developed. We also wish to determine the marketability of the dried sludge as a fertilizer before spending millions of dollars on pressing and drying equipment, and will be able to determine its marketability by the experience of Milwaukee in selling the 100 tons per day they expect to put on the market in 1925.

Many schemes have been suggested to us concerning utilization of sludges, such as briquetting for use as fuel, destructive distillation with recovery of gas, ammonia and grease, mixing with garbage tankage, etc., and we have given serious consideration to all of them, but the use as fertilizer seems to be most promising. We are still looking for ideas as to how we may improve our present processes, and our Chief Engineer, Mr. E. J. Kelly, and our Sanitary Engineer, Mr. Langdon Pearse, are always willing to try any new scheme that is based on sound engineering and that gives reasonable promise of success.

Table 11

Comparison of Alum and Acid as Filter Aids

FILTRATION TIME						
Filter Alum			Sulphuric Acid, 66° Be.			
Pounds per 1000 gal.	Minutes and Seconds	PH Filtrate	Cc. per gallon	Pounds per 1000 gal.	Minutes and Seconds	PH Filtrate
0	16:00	7.0	0	0	16:30	7.0
3	5:10	6.6	1	3.9	14:30	5.4
6	3:50	6.0	2	7.8	16:00	4.8
9	3:00	5.6	3	11.7	9:30	4.6
12	3:00	4.8	4	15.6	7:00	3.0
15	3:15	4.6	5	19.5	7:30	2.8
18	3:30	4.4	6	23.4	7:30	2.6
21	3:15	4.3	7	27.3	8:15	2.3

MODEL AEROPLANES

(*Continued from page 16*)

model design is encountered. There are so many inaccuracies which enter here that the formulas do not always hold true, but in spite of this want of precision they have proven fairly successful.

The design of the propellers depends upon the winds, or turns, it is possible to give the rubber as given by the following formula:

$$\text{Winds} = 1.75\,\frac{L^2}{W}$$

where

L = length of rubber motor in inches.

W = weight of each motor in ounces.

The above formula was devised by experiment, using the purest rubber obtainable.

The r.p.s. is determined by the duration calculated and the winds possible.

$$\text{r.p.s.} = \frac{\text{winds}}{\text{duration}}$$

The blade must be of sufficient width to give this calculated r.p.s. The pitch of the propeller is:

$$P = \frac{V}{(\text{eff.})\ (\text{r.p.s.})}$$

where eff. = approximate efficiency of propellers, usually taken from 0.5 to 0.7.

The diameter of the propeller in inches is calculated from the formula:

$$\text{Diameter} = K\sqrt{\frac{T}{V}}$$

where

K = 200.

T = thrust in ounces.

V = velocity in feet per second.

The lightest possible materials are used for the models. The motor base is usually made of clear white pine or straight-grain spruce. In the newer models channeled balsa wood spars are used. The propellers and main wing are made of balsa wood, which has eight-tenths the weight of cork, and is one of the strongest known substances in proportion to its weight. The elevator or, on the tractor model, the tail and rudder, are built of finely split bamboo strips, heated over a flame and shaped to suit. The motor base bracings are also of bamboo. The fittings, such as the propeller shaft, hangers, and hooks, are made of light piano wire. These small flying models vary somewhat in weight depending upon their size. The weight of a three-foot plane, rubber, wings, propellers, and all comes to about 1.75 oz. If the weight is greater the proper care has not been used during construction.

Small piano wire hooks are placed on the motor base to hold the rubber along the frame so that should the frame bend, the rubber will not jump across the shorter distance and snap it.

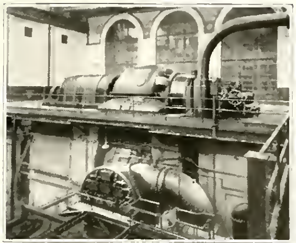
The wings are covered with a light Japanese tissue paper, and doped with a dilute solution of banana oil and acetone to shrink them tight. The wooden parts of the model are coated with banana oil to minimize weathering. All joints are tied with silk thread and glued.

It would be impossible to calculate the proper dimensions of the various model parts, as the variations in the different samples of material would be enough to vitiate the calculated results. This is therefore rather a cut-and-try proposition, and the craftsmanship of the model maker here comes into play. It is only after months of consistent building that the art of model making is acquired. The detail work is the real determining factor of a good model.

Other types of motive power for small planes are gasoline motors, compressed air motors, and steam plants. Planes driven by other than rubber bands are called power driven models. Gasoline motors of such a small size have not proven very satisfactory. The possible duration from a compressed air plant is limited because of lack of carrying capacity for the engine. Steam has proven to be the most successful for power driven models. By using a small twin-opposed engine of some five-eighths inch bore and three-fourths inch stroke, coupled to a flash type boiler, made of steel tubing wound in a coil, with a blow lamp superheating the steam, extremely good results have been obtained. The machines driven by these power plants are much larger than the ones used for rubber-driven types of models.

One cannot receive more of a thrill than after one has spent days building a model to see it fly minute after minute, hundreds of feet through the air.

The author wishes to make acknowledgment to Mr. Ellis Cook, '20, for much of the material herein presented.



20,000 K.W., 80% P.F., 1800 RPM. Steam Turbine and Alternator Unit with 32,000 sq. ft. Surface Condenser in Waukegan Station, Public Service Company of Northern Illinois. Allis-Chalmers Circulating and Condensate Pumps, Motor Driven, are also installed in this Plant, together with four 10,000 KV-A, 135,000 Volt Transformers.

Allis-Chalmers Manufacturing Company

having greatly extended and improved its manufacturing facilities for steam turbine units, particularly of the larger sizes, is now building these units in any commercial size.

The placing in regular service several months ago of the 20,000 K.W., 80% P. F. unit for the Public Service Company of Northern Illinois, as illustrated herewith, will be followed by a 30,000 K.W. unit now building for the same station.

Units ranging in capacity from 20,000 K.W. to 30,000 K.W. are now under construction in the Allis-Chalmers plant.

In its more than sixty years of service Allis-Chalmers and its predecessor organizations have successfully built more than eleven million horsepower in steam-power equipment.

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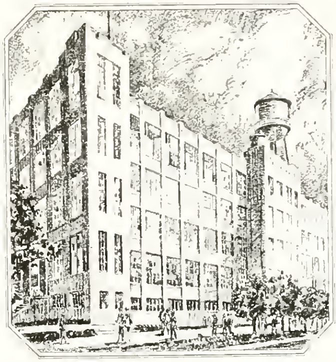
Industrial Plants



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OLD CIVILIZATIONS AND OUR OWN

(Continued from page 14)

falls greatly in its position, and religion atrophies. For civilization has reached the point at which energy expresses itself through money, and faith is subordinated to that representative of wealth. With the decline of religion, the period becomes characterized by agnosticism, atheism, and pessimism.

Religion and the holy ties of the family seem to have some hidden relationship or connection, for the lapse in religion is accompanied by the decay of that most important social unit. In Rome, at this period, divorce became merely a formality. Following the relaxation of the family ties, population, especially native population, tends to stagnate, if not actually to decrease in numbers. The reason for this Tacitus explains fully in his statement, "— — the advantages of childlessness prevailed".

During the period which we are now describing, society literally "goes to pieces" in a tremendous revolution. Morality decays; agriculture declines; cities grow; pauperism increases; wealth becomes more and more restricted in distribution and more and more powerful; the gap between rich and poor begins to yawn as an awful chasm. To summarize, faith—in religion, in self, in humanity, in everything upon which society ultimately rests—is lost; and when this stage is reached, the great mass of population has nothing to look forward to, no ambition to foster. Nothing is left by which the integrity of society may be maintained, except a mercenary police power. Decay has attacked the very roots of society.

The climax is reached. For the denouement of our story of civilization, Rome gives us one of the best examples. In Rome, at this period, the devitalized society could no longer provide funds for the maintenance of the tremendous police and military force necessary, and the barbarians poured unchecked across the Danube and the Rhine. By 400 A.D., the most martial and energetic race the world had ever seen had been so thoroughly exterminated by men of the economic type of mind, that petty bands of sorry adventurers roved where they would without meeting an enemy capable of facing them, save other adventurers like themselves. Nor was this the fate only of Rome. Following the decline of each nation with the disorganization of society, a seeming divine wrath has visited itself alike on all civilizations. Magnificent, haughty Carthage is no more, for her walls and buildings were torn down, stone from stone, and her broad streets and beautiful gardens were plowed up by the vindictive Romans. Athens was all but razed by her jealous neighbors, and finally with her victorious enemies lapsed into oblivion. Egypt the imperial, cradle of civilization, has fallen the victim of numerous conquerors, and for three thousand years has been

(Continued on page 32)

HELIUM

(Continued from page 8)

that the atoms of many elements may be split yielding hydrogen. The elements boron, nitrogen, fluorine sodium, aluminum, and phosphorus have been made to yield hydrogen when subjected to the influence of alpha rays.

Sir Ernest Rutherford used the scintillation method invented by Crooks for counting visually the number of alpha particles given off by a definite quantity of radium in a measured time. The volume of helium produced has been determined. In this direct way it has been determined that 2.7×10^{19} particles or atoms of helium are contained in one cubic centimeter of gas under standard conditions of temperature and pressure. This is Avogadro's constant, of importance in all work with gases. These alpha particles can be detected individually by electrical means, and counted. Their tracks-

(Continued on page 34)

EXPERIENCES OF AN ARCHITECT

(Continued from page 15)

the big things, the important things, mean nothing. They will talk for hours about the height of a door, the color of the windows, or the number of the front steps, but will ignore essential details of construction. This is all in the day's work, however, and it remains for the practicing architect, the future architect in embryo, and those interested in architecture to make up their minds that a part of their life work must be directed to the educating, if possible, of the building public.

The work in my office has been of a varied and interesting nature, having to do with the home, the church, public and semi-public buildings, as well as those of a strictly commercial nature. The greatest experience is to be obtained with those buildings which are supposed to be directed by large building committees, which are usually most unwieldy and amusing. One's opportunity for studying human nature is great, and if one can please so many of different minds, the gratification is correspondingly greater.

St. John's Lutheran Church, Sterling, Illinois, was completed this year at a cost of $102,000 complete. The building is approximately 55 by 104 feet in size. The first floor and balcony seat close to a thousand people.

SUMMER CAMP

(Continued from page 7)

Samuels, walloped Sayner to the tune of 12 to 4, Harrower pitching the first seven innings with 11 strikeouts to his credit. We cannot fail to mention the game with Red Arrow Camp because we succeeded in trimming such stars as Rollie Williams, Barnum, and C. Miller, all of the University of Wisconsin, by a score of 5 to 3.

The social season of Trout Lake began for us as soon as we arrived at camp. The Trout Lake pavilion, that place of worship of our town sheiks and dashing engineers, was well frequented, in spite of the fact that it rained every time a group started out for the alluring place. This was indeed very mysterious and we still wonder whether or not Professor Wells had any connection with the weatherman.

A few days before the Fourth of July, we all began to lay our plans for a three day vacation. Finally, the Fourth came and the excited groups left camp, to carry out their own plans. Some hiked up to the lumber camps, some took a canoe trip from Boulder Junction around to Trout Lake, some explored Fence Lake and White Sand Lake, and others ventured to Woodruff and Minocqua. Although we were not due at camp until Sunday night, we were all back by Saturday afternoon, eager to relate our most thrilling stories. It must be understood that there was no lack of fantastic color in these tales. It was surely a happy reunion for our hardy surveyors whose boldness and brave hearts were the admiration of all present when, at supper that evening, they made a fearless attack on the roast beef.

Of course, other things beside mere play occupied our attention during working hours. The work started on Monday, June 2, with an unbelievable amount of enthusiasm, which afterwards proved abnormal. The course was under the able direction of Professors Wells and Stevens, who surely had their hands full. The work consisted of learning the whys and wherefores of chains, levels, transits, plane-tables, scout boards, sounding apparatus, and the current meter. We were divided into parties and pursued the tracks of previous Civils, exploring and re-exploring the various polygons, and setting our findings in field notebooks in a systematic way.

The homecoming fever became general during the last week as the fellows prepared for their return journey, but when the day had come and Charlie had picked us up, we turned with regretful eyes to see once more the winding trails, the tall pines, and the clear waters of Trout Lake and to wish that our six weeks of work and play had just begun.

OLD CIVILIZATIONS AND OUR OWN

(Continued from page 31)

unable to call her soul her own. The wondrous cities of Babylon, Tyre, Sidon, Troy, and numberless others—where are they?

"The giant forms of empires on their
way
To ruin one by one,
They tower and are gone."

This is our summary of the phases common to all civilizations, the important phases, the phases which provide some basis for an attack on the impending problem. True, it appears in general as merely a statement of opinion with the substantiation of but few references. However, it has proved impossible to include herein the citation of a sufficient number of references to make this course worth while. We must therefore leave to our reader's knowledge of history the simple matter of connecting our general outline with the histories of any or all previous civilizations. And we make this statement only after actually having ourselves traced out the connection of which we speak in the histories of a number of civilizations. For modern history, as for Roman history, this was easily accomplished. Fewer pertinent facts are afforded relating to the histories of Greece, Carthage, Egypt, Babylon, and other ancient civilizations. However, those which do exist point infallibly to the general applicability of our outline.

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HELIUM

(Continued from page 31)

have been photographed by the water-droplet method.

The spectrum of a gas gives a deep insight into the structure of its atom. Professor Millikan in his photography of the extreme ultraviolet has shown that there is an intimate relationship among the atoms of all the light elements. The units of structure are the hydrogen and helium atoms.

Since helium is one of the products of spontaneous decomposition in radioactive substances the amount present in any mineral has been used to determine the age of geological deposits. A knowledge of the occurrence and distribution of helium among minerals would certainly throw a flood of light upon many fields of science.

[1] The U. S. ZR-1, named the Shenandoah, is 680 ft. long, 78 ft. in diameter, 96 ft. high, with a gas capacity of 2,150,000 cu. ft. Total lifting power when filled with helium is 130,000 lb., dead weight about 75,000 lb., speed between 60 and 70 miles per hour, with a cruising radius of more than 4,000 miles. It is equipped with six 300 h.p. engines and carries a crew of 9 officers and 22 enlisted men. It is housed in a hangar which is nearly 1,000 ft. long, 350 ft. wide and 200 ft. high.

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ARMOUR TECH ATHLETIC ASSOCIATION

Treasurer's Report, College Year 1923-24

Receipts

Cash Balance, September, 1923		$ 376.17	
753 students' fees, $7.50 each, 1st Semester	$5,647.50		
Less refund (3 students did not attend classes; and 3 special students)	45.00	5,602.50	
689 students' fees, $7.50 each, 2nd Semester	5,167.50		
Less refund (2 students did not attend classes; and 2 special students)	30.00	5,137.50	
Interest—on bank balances		70.03	$11,186.20

Expenses

Band (special instruments)		301.00	
Baseball		119.94	
Basketball		20.00	
Boxing and Wrestling		214.88	
Cycle	3,136.10		
Advertisements, class and other donations, and cash sale of books	1,130.50	2,005.60	
Directors and Coaches		4,359.00	
Armour Engineer	2,331.75		
Advertisements, Alumni and Faculty Subscriptions	1,613.43	718.32	
General Expense	147.91		
Tickets Sold	3.00	144.91	
Golf	227.17		
Balls sold	6.60	220.57	
Musical Clubs	565.80		
Concerts, Home Concert and Advertisements	217.75	348.05	
Radio (special equipment)		75.61	
Swimming		44.89	
Tennis	415.38		
Refunds from meets	53.94	361.44	
Track	629.46		
Refunds from meets	191.03	438.43	
		9,372.64	
Cash Balance		1,813.56	$11,186.20

Bi-Polar Gearless Electric Locomotives for C., M. & St. P. Ry.

One of a new series of electric locomotives for the Chicago, Milwaukee and St. Paul Railway was recently placed on public display in Chicago on its delivery trip from Schenectady to the Milwaukee road's electrified division in the Rockies. The machines are of the gearless type similar in design to those in use by the New York Central Lines since 1906. The driving equipment consists of twelve direct current, bi-polar motors with a continuous rating of 265 h.p. each at 1000 volts. Each motor armature is keyed directly to a main driving shaft so that reduction gearing, used in street car and small locomotive design, is eliminated. With the moderate motor speed of 500 r.p.m., the locomotive will attain a speed of 65 miles an hour with drivers only forty-four inches in diameter. This gives the locomotive advantages in several ways over the previous type used by the railroad with six 68 inch drivers driven by twelve motors through reduction gears and quill springs. In the older machine with high drivers and two motors per axle, the body was of necessity raised high off the rail, and to keep the rigid wheel base as small as possible, the motors were placed above the axles and projected into the body, where they occupied space that might otherwise be used for switching apparatus. The result was a bulky, almost topheavy exterior appearance with a cramped interior where headroom and bodyroom were at a premium. The new machine, with twelve motors directly on the axles, while only slightly less powerful and heavy than its predecessor, is very much more compact and sightly in appearance. It allows more space for its operator, with less resultant danger from high voltage switch gear. Using twelve driving axles instead of six presents two further advantages. The weight per axle and axle size are drastically reduced and the available starting tractive effort of the new machine, which weighs 260 tons is approximately twelve per cent greater than that of the old machine, which weighs 275 tons.

The machine operates on a trolley voltage of 3000 volts and motor control is by a modified type of the usual series-parallel controller which allows both a voltage control and a field control through tapped field connections. The low running point is with twelve motors in series with 250 volts across each; The high running point with three motors in series, four groups in parallel, with 1000 volts on each motor. Intermediate points are, of course, with six motors in series, two parallel groups, and four motors in series, three parallel groups. Field control, in addition, gives eight running points. The result is extreme ease of control for the driver with a minimum of rheostat losses. As in the older locomotives, regeneration is used, both for braking on the level and on easy grades and for feeding energy back into the line on the steep down grades. When regeneration is taking place, two of the motors are used as exciters to furnish the field supply for the remaining machines, which are operated as separately excited generators.

The body is of the articulated type in three sections, and is mounted on the four trucks in such a manner that lateral motion is permitted between body and truck. With this arrangement easy riding qualities were observed on a test run at 80 m.p.h. although the machine was designed for a maximum speed of 65 m.p.h. As the cars are handled for the major portion of their run by steam locomotives, and are equipped for steam heating, the electric locomotive is of necessity equipped with an oil fired heating boiler located in the middle cab.

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Vol. XVI JANUARY 1925

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The Complete Project for the Standard Oil Building New York City

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"The New Architecture"

A DISTINCTLY new tendency is apparent in architectural thought and design today. Architects are designing in masses — the great silhouette, the profile of the building has become of far greater importance than its detail.

There is a new vigor and ruggedness even in buildings which are conventionally classic in their detail. Masses mount upward, supporting the tower, accentuating its height. The new architecture is tending toward great structures rather than multiplicity of detail.

Certainly modern invention — modern engineering skill and organization, will prove more than equal to the demands of the architecture of the future.

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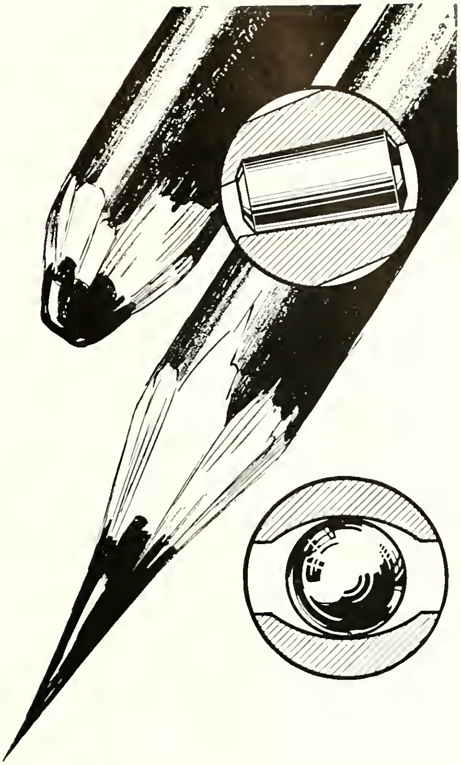

THE surest thing about a pencil with a fine, long point is that the fine, long point will soon wear off. Five minutes of rapid note-taking, and you're down to where the point is broad, and *there* the lead lasts much longer.

Here, in principle, you have a key to the superiority of a roller over a ball bearing.

Two surfaces, separated by a ball, must rest upon points in the circumference of the ball. They rest upon points because there's nothing else in the circumference of a perfect ball but points.

Two surfaces that are separated by rollers, however, rest upon the broad length of the surface of the rollers.

Although made of steel instead of graphite, and thus infinitely more enduring, the difference in life between a roller bearing and a ball bearing is nevertheless typified by the sharp vs. dulled pencil point. The broader the surface over which the load is distributed, the less rapid the wear—and the longer the life of the bearing.

Timken Bearings, in addition to being roller bearings are also *tapered* roller bearings. Because of the taper, they withstand the loads which are called "end thrust," as well as those directly at right angles to the axis in which the bearing is mounted, called "radial load." Only tapered bearings have the capacity in one bearing to withstand both these loads.

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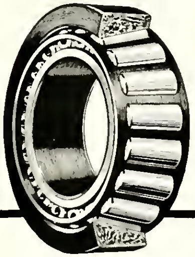

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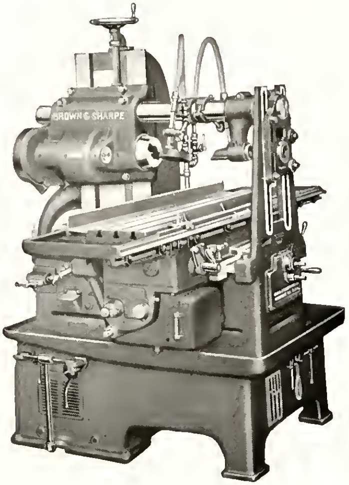

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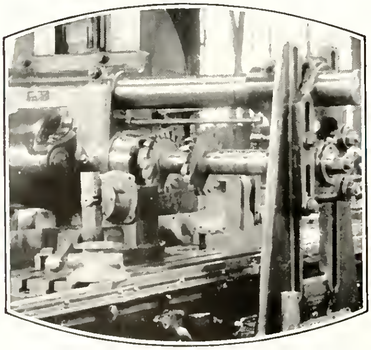

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Armour Institute of Technology

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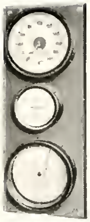

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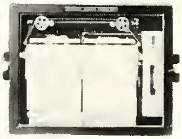

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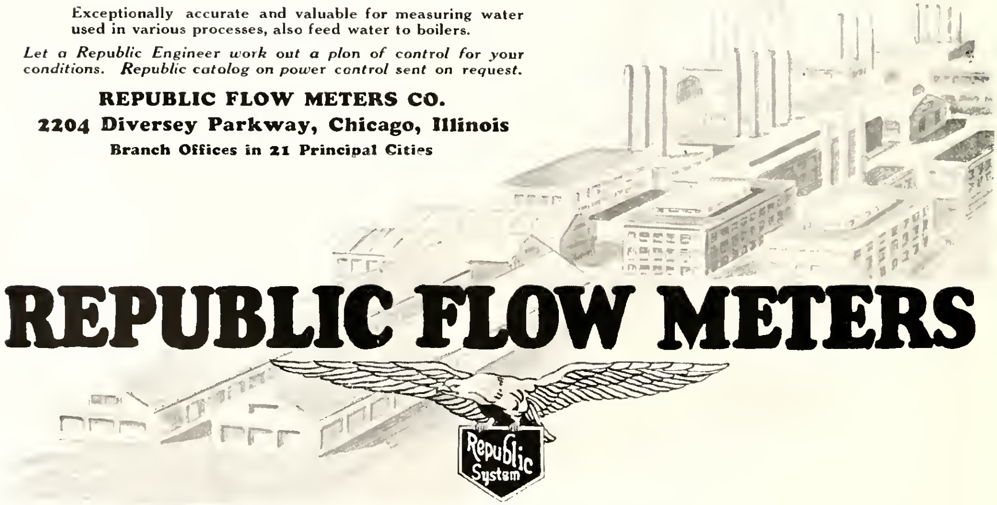

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RECENT DEVELOPMENTS IN BOILER FEED WATER TREATMENT

By

I. J. BREADY, '20

Engineer, The Permutit Co.

THE last twenty years in the history of power plant engineering has seen some remarkable developments in the methods of treating feed water for boiler feed purposes. During this period of development the methods of feed water treatment have gradually changed from the original method of treating the feed water with various chemicals commonly known as boiler compounds after the water was in the boiler, to the modern method of purifying and softening water outside of the boiler and delivering it in the most desirable condition for steam generation. In all well designed power plants, every effort is made to return to the boilers all possible condensate, some plants getting back more than 95 per cent. This enables the boiler to be operated under the most efficient conditions for the single purpose of steam generation, eliminates the scale problem, and permits operation of the boiler for remarkably long periods without having to be opened up for cleaning.

The interest of engineers at the present time in water softening methods is remarkable, and a very large majority of them will agree that the proper plant to treat and purify feed water is outside of the boilers. Softening plants are now made so simple that they require but little attention for satisfactory operation. In addition they are made in sizes suitable for boilers of from 25 horse power up to any capacity desired; the price of the plants is low enough to be within reach of any owner of a boiler plant. The fuel saving, and saving in labor and repairs for the boilers soon pay the cost of the investment in a properly designed softening plant.

Water supplies for boilers may be roughly classified as hard and soft, muddy and clear. There is no question but that an engineer would choose a clear soft water for boiler feed if given his choice.

Mr. Ira J. Bready.

If nature and the man who located a certain power plant have failed to provide such a water, it is good business to get it by any means within power. This clear, perfectly soft water, produced at a minimum of expense is what all engineers have been trying to obtain for years. With this object to be obtained in mind, I will describe some of the plants that have been used and the progress that has been made.

Figure 1 illustrates the earliest form of water softener used for power plants. It was developed after the engineers recognized the fact that it did not pay to make a water softening plant out of the boiler.

This plant is known as an intermittent water softener. The tanks are usually made of wood. The chemicals usually used are lime and soda ash. They are added first to one tank of hard water and then to the other. The water and chemicals are stirred together and allowed to settle. In this way each tank goes through a cycle of operations: filling, charging, agitating, settling and finally emptying. The results obtained depend on the care used in testing the hard water at the time the tanks are filled and preparing the charges of chemicals to suit the analysis of the water. With a variable water extreme care is needed. The time of agitation, amount of old sludge left in the tanks and the proper filtering of the softened water, all affect the results obtained. The space occupied by this apparatus and the labor and time required for its proper operation brought on the market the continuous softener.

Figure 2 shows what is known as the continuous type water softener. It was first developed to avoid some of the labor connected with the operation of intermittent softeners and to proportion automatically the lime and soda ash to suit the amount of hard water flowing to the softener. A charge of chemicals is made up usually once in twelve hours and as the hard water flows into the top of the softener the chemicals are proportioned to the quantity of hard water entering. Usually the mixture flows down a central down-take and the precipitated hardening salts settle to the bottom of the tank and are blown off twice a day to the sewer. The water then rises to the top and flows through a filter to the heater or storage tank.

In the first large plants put in for railroad and power plant use, filters of excelsior or wood fibre located at the top of the settling tank outside the down-take were used. On account of the unsatisfactory service of excelsior filters, all modern continuous as well as intermittent softeners are equipped with sand filters of the pressure or gravity type.

The difficulty of treating waters of varying hardness is apparent at once. It is a problem on which much thought, labor, and money have been expended. With such waters an intermittent softener is best in principle as the average composition (hardness) of a tank full of water can be determined by test. However, the results obtained by either method depend very definitely on the care and skill of the softener attendant.

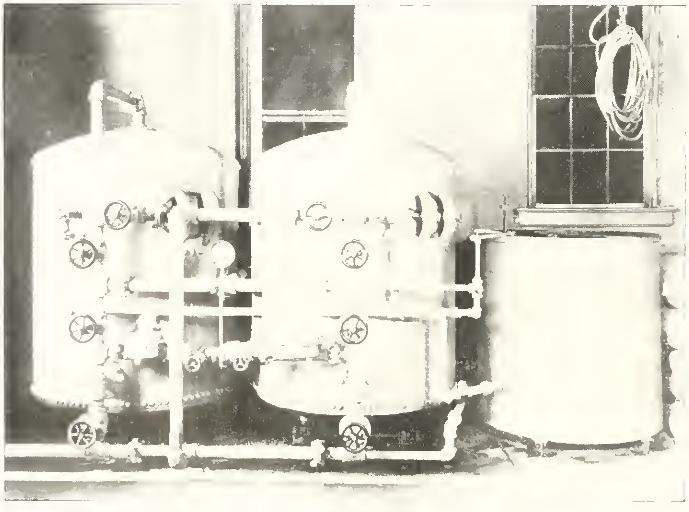
It was frequently found that hot or warm water was available in large quantities and could be pumped to the softener and treated in the continuous machine. This water came from condensers, etc., and softened more rapidly and thoroughly than cold water did.

At some plants large amounts of exhaust steam were available and to take advantage of this the heater softener shown in Figure 3 was developed.

The water enters the heater, follows the general course as in a continuous softener and finally passes through sand filters. The best results are obtained when boiling temperatures are used. With most waters this means more or less deposits in the heaters and frequent cleaning of the same. That this fact is recognized is shown in the specifying of two heaters on heater softeners by most consulting engineers; this allows the cleaning of scale and mud from one heater while the other is in use.

As to results obtained by any of the above processes of precipitation, it may be said that the cold water plants reduce waters from a given hardness to 4 or 5 grains per gallon of scale-forming solids, and the hot water plants reduce to 2 or 3 grains of scale-forming solids if water is treated at boiling temperature. In this latter case it is necessary also to figure that the tests on the water leaving the hot softener will vary in proportion to the amount of condensation and that it is not proper engineering practice to use a thermostatic valve to keep open heaters up to boiling temperatures with live steam, in order to soften water, if it can be done in any other way. In many of the largest power plants, the requirements of the plants are such that the feed water will run from 180° F or less, up to 210° F, so that if boiling temperatures are necessary for chemical reactions and dosage of chemicals there will be variation in results when the temperature varies. If one is handling a variable water, there is still a further chance for over and under treatment.

It is a known fact that in softening with lime and soda ash it is necessary to use an excess of chemicals to soften the water. If the water varies in hardness it may be improperly treated and rendered unfit for industrial and domestic use as well as unsuitable for boilers.



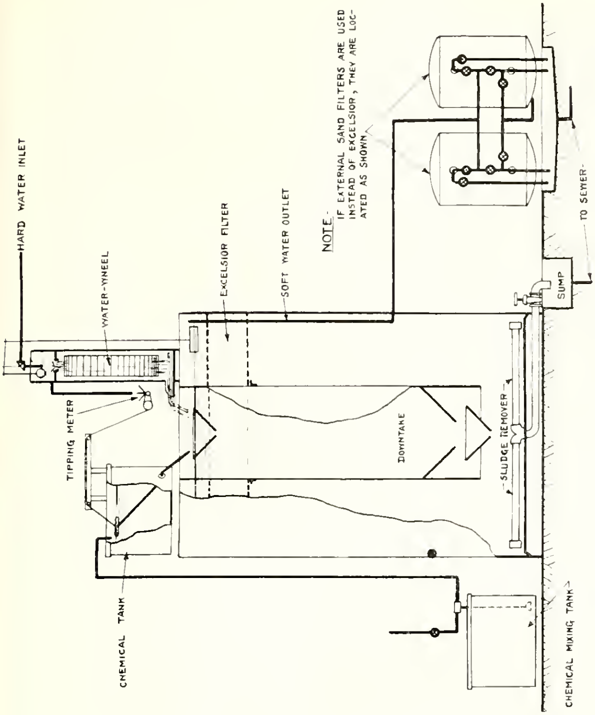
A double unit vertical pressure Zeolite softener, similar in principle to that represented in Figure 4.

Often the precipitates remain in such a condition that they will pass through the sand filters and lime up feed pumps, hot and cold water pipe lines, and injectors, causing expense and difficulty. This liming up or clogging of water lines, ejectors, and pumps can be avoided in taking advantage of the progress made in water softening.

The goal in water softening practice is a clear water, containing no hardness, to be economically obtained with a simple apparatus. Such water can be obtained from the softener shown in Figure 4. The water has no hardness. It is known commercially as Zero water. It will not make scale, sludge, or mud when used for boiler purposes. The water enters the plant under pressure and leaves under pressure. The plant shown in this sketch is a Zeolite water softener. It produces water of Zero hardness, suitable for boiler, industrial and domestic use. It is theoretically and actually impossible, even if the reaction could be driven to completion, to produce Zero hardness water by the precipitation or lime-soda process as the precipitates themselves are soluble in water. In this form of apparatus the water enters the steel tank under pressure at *A* and passes through the bed of Zeolite material *B* with which the tank is filled. This material has the power of exchanging sodium for calcium and magnesium in the process of softening water. The soft water leaves the softener under pressure at *C*.

No chemicals are added and the mechanical problem of controlling the feed of chemicals is avoided. Any variation in the hardness of the raw water is automatically taken care of without constant chemical testing or adjusting of feed devices. When the softener has taken care of its rated capacity, the Zeolite contained in the shell is brought back to its original condition by passing through it a solution of common salt. This salt solution passes from tank *D* up through the Zeolite bed (or sometimes down depending upon the particular design of the apparatus for the case to be handled) and through pipe *E* to the sewer, carrying off all scale-forming materials in clear solution. No sludge is formed and no problem of sludge disposal exists. A meter is provided to indicate when the softener has passed the quantity of water it was designed to soften and a simple test is made to check the result when working on a water of varying hardness.

It can be readily seen that by installing a softener of this type to give the desired capacity of water at its hardest period, that the possibilities of over or under treatment are eliminated in the case of a variable water. To further il-



NOTE- IF EXTERNAL SAND FILTERS ARE USED INSTEAD OF EXCELSIOR, THEY ARE LOCATED AS SHOWN

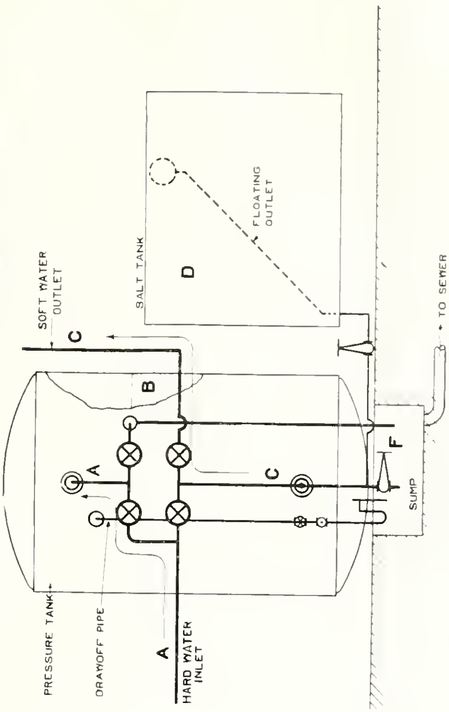
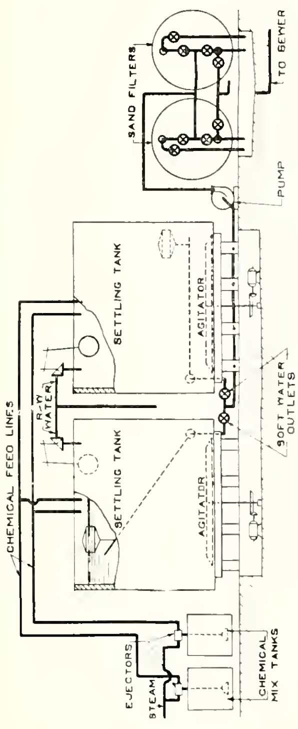


Figure 2. The continuous lime-soda plant.
Figure 4. A Permutit Zeolite plant.



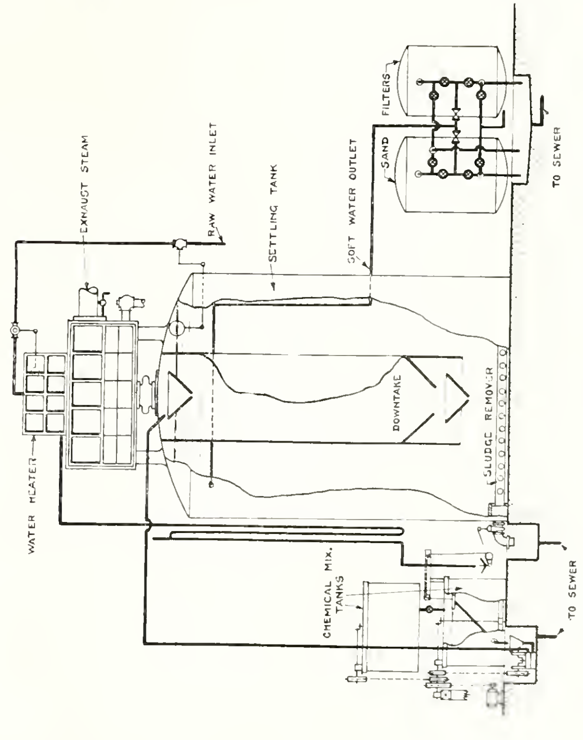


Figure 1. An intermittent lime-soda plant.
Figure 3. A hot-process lime-soda plant.

lustrate this point and also to give a specific case of the installation of such equipment note Figure 5.

This is a reproduction of a chart kept by the Hammersley Manufacturing Co., of Garfield, N. J. The experience of this company may be cited as an example because they had used other forms of water treating equipment, and had kept records which could be compared with the results of the latest equipment installed.

This firm has two boiler plants, one consisting of five horizontal water tube boilers having a total of 1,080 h.p., the other having three 400 h.p. water tube horizontal boilers, which develop 1,200 h.p., or a grand total boiler horsepower of 2280 normal rating. All boilers are B.&W. Minimum returns were 10 per cent, so that it was necessary to figure on 216,000 gallons in 24 hours for boiler feed purposes.

The water supply comes from 16 artesian wells varying in depth from 145 feet to 250 feet. The hardness is variable, and showed a maximum of 16 grains per gallon and a minimum of 7 grains.

The equipment consists of two 10 inches diameter by 10 feet 8 inches long Zeolite water softeners, which were placed in operation on September 17, 1920. Prior to this installation a lime-soda water softener of approved design was in use which reduced the total hardness of the water to nearly 5 grains per gallon. In spite of this trouble was experienced. The storage tanks were lined with a deposit of scaly scum. The boilers had to be cleaned every three or four weeks and since oil was used for fuel, the outlay for burned-out tubes was very considerable. The scale formed from the lime-soda treated water was soft and like dry clay, very crumbly. Foaming and priming also occurred.

Figure 5 is a reproduction of a large scale chart kept by the operating engineer of the Hammersley Plant. The vertical scale denotes grains of hardness per gallon. The upper solid line shows the total hardness of the raw water supply. The dotted lines indicate hardness of softened water.

After installing the new water softener, Zero water was delivered from the softeners through a very long transmission line to the boilers. For some period of time the Zero water dissolved the scale from these pipes and therefore showed a half grain or more of hardness at the boilers. As soon as this old scale had been dissolved, however, zero was noted at the boilers and remained constant.

It will be noted that in a general way the variation in hardness of the softened water delivered by the lime-soda plant corresponds to the variations in hardness of the raw water supply. In other words, when the raw water increased in hardness, the softened water was not dosed with extreme accuracy and therefore showed a variation although in a very uncertain manner.

Shortly after the installation of the new water softener the hardness of the raw water increased very considerably and it is important to note that no variations in hardness were caused by this fact. Although operating on a water supply fifty per cent harder than the plant was designed for, Zero water was constantly delivered from the softeners, and this without any extra regeneration or special operation.

If the size of the softener is correctly selected to take care of the required volume of water, the water from the softener is always of Zero hardness. If a plant is seriously overloaded, the worst possible effect would be that the water would have a slight hardness.

In a large well known manufacturing concern a short distance from Chicago a Zeolite water softener handles 1,080,000 gallons of water for boilers every 24 hours. The return condensate is negligible so that the feed water is about 100 per cent makeup. In a large central station plant in Chicago the opposite of this condition exists. Return condensate amounts to 95 per cent, therefore the boiler feed makeup to be softened is only 5 per cent of the total water evaporated. However, this 5 per cent amounts to 288,000 gallons in 24 hours and a Zeolite plant handles this boiler feed supply.

In both of these plants, since nothing but condensate and clear Zero water is used, water heaters, boiler feed pumps, boiler feed lines, boilers and blow-off lines are maintained in a scale- and sludge-free condition.

The softened water used for makeup has been produced at a fraction of the cost, including interest on the investment, operating cost, steam used, etc., of what distilled makeup water would cost. In producing this soft water the work has all been done in passing the water through the Zeolite water softener under pressure; the trouble of scale formation and priming has not been transferred from the boilers to a distilling apparatus. The water itself is clear, naturally alkaline and thus of itself non-corrosive. Any dissolved gases are liberated in properly designed open feed water heaters of large capacity. There is no suspended matter in the water and none can form, so the boiler blow-off is brought to a minimum and within definite control of the plant operator. Blowing down becomes an accurate and routine matter and not a matter of uncertainty as when suspended matter from various causes is present.

(Continued on page 73)

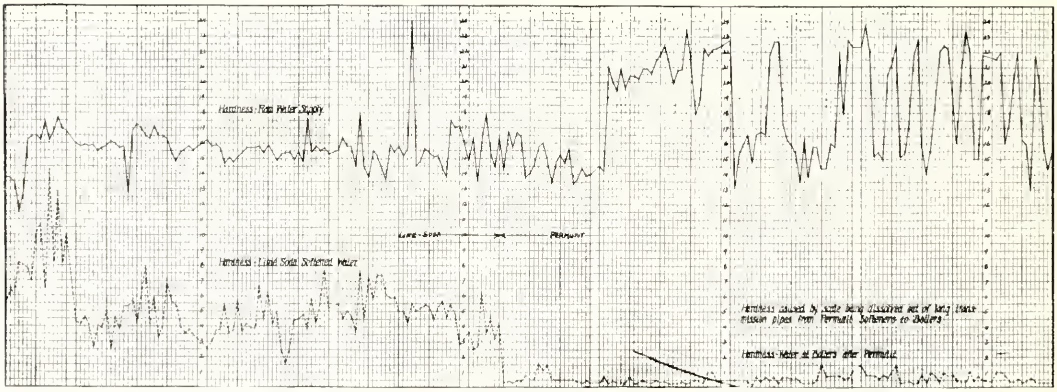


Figure 5. Operating chart of a water softening plant, contrasting the lime-soda, and Zeolite processes, in effectiveness.

PREPARATION OF COAL FOR THE WESTERN MARKET

By

BENEDICT SHUBART, '99

WESTERN market demands create differences in mining and preparation between East and West that make it almost impossible for eastern engineers to design a successful plant for a western mine. In the East the market demand is largely for steam coal. The domestic demand is subordinate. The large demand is therefore for small coal, and little attempt is made to produce a large percentage of lump coal. Freight hauls are short, and the freight rate is a comparatively small part of the total cost to the consumer. In the West these conditions are almost inconceivably reversed. The steam demand is small, the ordinary steam coal user does not buy in large quantity, and he has the choice of a wide market. As a result, the small sizes of coal are sold at a price below the cost of production, even in a good general market. The domestic demand for large coal regulates production. Steam coal is a by-product. Every effort is spent to secure, not only the largest proportion of large coal, but also the abnormally large coal that is demanded by the domestic trade in the West. Strange to say, the average household user will pay a fancy price for coal so big that it must be broken up by pick before it can be used.

This strange lack of balance between steam and domestic users produces a condition that is puzzling to the operator, and keeps him continually worried, if he expects to leave the balance on the right side of his ledger. When the domestic demand is good and the steam demand light, there is an excess of the small sizes. Frequently it is necessary to dump these small sizes, and much of this coal is never reclaimed. It is not only a dead loss, but there is an additional expense incurred in getting rid of it. All this must be charged against the larger sizes of coal for the domestic user. At times, particularly in the summer, the domestic demand is non-existent. The steam demand must be taken care of, so the operator is given the pleasing prospect of taking what is normally his best coal, crushing it down to steam sizes, and then selling it at prices that are frequently less than the cost of production.

Western freight rates on coal are high. Western distances are long. Coal shipped from Colorado or New Mexico to California, and other coast points, carries a freight rate many times the selling price of the coal at the mine. If the operator is to avoid complaints, adjustments, and loss of trade, he must and does use every effort to secure the most perfect separation of each size, so as to avoid degradation and car bottoms.

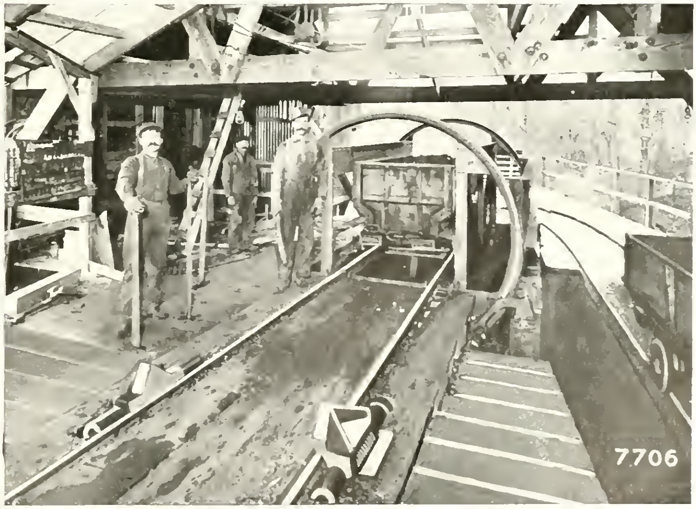
Another condition unusual in the East is that of box-car coal. The coast trade demands that practically all large-size coal be shipped in box-cars. There are several reasons for this, two of the most important being the actual degradation the coal undergoes in open cars when shipped these long distances, and the actual loss through pilferage during the many days' journey and the many long stops made in cold weather at points where the coal is pitifully needed by the poor.

These conditions have developed a system of handling and separation in the West that is entirely different from eastern methods. In the East, the run-of-mine tipple is not uncommon. There is scarcely a single one in the West. In the East, many of even the largest tipples have plain gravity screens with two or three loading tracks. There is no such tipple in the West. The result of all these handicaps is the development of a very elaborate system of mining, screening, and loading coal that is highly efficient and correspondingly expensive.

Starting in the mine, the mining system itself is laid out so as to secure the greatest percentage of large coal. This general statement must be modified to admit that the first demand of any mining system in the West is that of safety. Several unfortunate, seemingly unavoidable, explosions have trained the western operator to put safety first. This too demands the production of large coal. Heavy shooting and breaking of coal produces dust, which has been found to be the most menacing ingredient of mining danger.

At the tipple, the dumping is arranged so as to get a minimum amount of breakage, together with as perfect a sizing as possible with no undersize left in any particular grade of coal. Breakage, of course, would increase the amount of small coal shipped, with a decrease in the market value. Small coal mixed in the larger sizes means complaints, deductions, and possible loss of trade. The apparatus on the tipple is consequently quite elaborate and intricate.

After the trip of cars is delivered at the tipple, it is fed by a car haul into a rotary dump, which turns the car completely over and empties the coal into the feed hopper, from which it is fed out either by a reciprocating feeder, consisting of a plate that oscillates to



Courtesy the Link-Belt Co.

A rotary dump.

and fro, or by a conveyor feeder made up of a moving steel apron which conveys the coal slowly out of the hopper and discharges it into the shaking screen.

Shaking screens in the West are usually longer and narrower than those in the East. The typical screen is six feet to eight feet wide and from thirty to forty-five feet long. It is usually in two sections, shaken by eccentrics which are so set as to oppose the motion of the two screens, preventing excessive vibration of the tipple. These long screens are necessary in order to span the unusual number of loading tracks rarely less than four, and frequently up to six in number.

The shaking screens usually have plate bottoms containing circular perforations from $1\frac{5}{8}$ inches up to 8 inches in diameter. These screens are supplemented by re-screening machinery which will be described later. A set of shaking screens weighs about six tons. The screens have an oscillating motion of 6 inches to 8 inches, with a speed of 90 to 120 r. p. m.—quite a large mass to agitate so violently. The normal number of sizes made by the well constructed tipple is usually eleven, ranging from dust to lump coal over the 8 inch perforation, and including run-of-mine coal. Some mines, particularly during hard times, will make fancy preparations of unusual sizes in order to secure a trade advantage, and most tipples are designed so that such competition can be met.

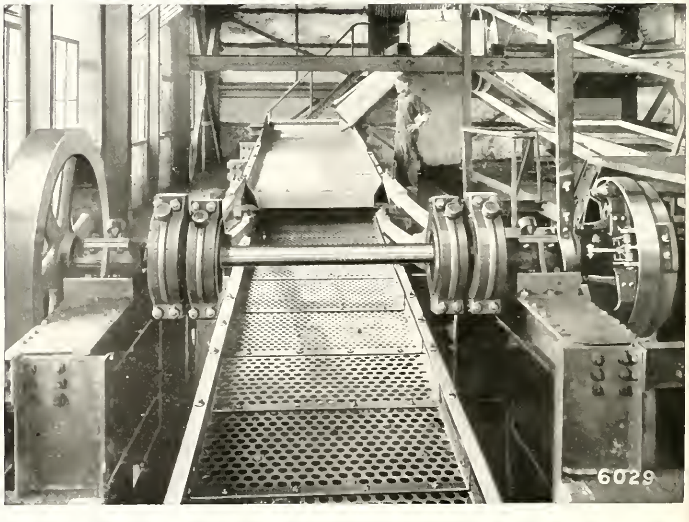
From the main shaker screen, the coal may go directly to gondola cars or box-cars, but late practice requires that the larger sizes of coal (all above slack or $1\frac{5}{8}$ inches coal) be shaken gently onto loading booms for cleaning and for gentle loading into the cars. Where open cars only are used, the loading boom is a simple proposition, consisting of a straight apron conveyor, pivoted at the middle, and hung at one end by a small electric hoist which raises or lowers it at the operator's touch.

For most mines, it is necessary to install an entirely different type of boom so as to be prepared to load either open cars or box-cars without droppage of coal. For this work the Link-Belt Company has developed the Knox loading boom, consisting of a boom similar to those already mentioned except that it is pivoted at the receiving end, allowing it to be swung laterally as well as raised and lowered. This same boom, when loading a box-car, will swing alongside so as to be parallel with the car to discharge the coal into the box-car chute. It is quite common now to use a mechanical box-car chute in place of the old gravity chute. The gravity chute is simply an inclined chute which leads the coal from the end of the loading boom into the side of the box-car and onto the box-car loader. This gives certain breakage, and in view of some of the very large coal to be handled, frequently does not leave sufficient clearance between the chute and the top of the box-car. The mechanical apron, which is merely a small conveyor, is made so as to run in and out of the car on wheels. When the car is ready for loading, the conveyor is run into the car, leaving one end projecting out. The coal is discharged onto this outer end from the loading boom, and it is then conveyed gently within and laid upon the box-car loader.

The box-car loader is another conveyor device for taking the coal from the car door and placing it in the ends of the car. Where men shovel the coal, or where the coal is dropped violently into the car, the breakage is great and the labor cost heavy. In fact, where the tonnage is large, men cannot shovel fast enough to get the coal into the car and some such mechanical device is necessary.

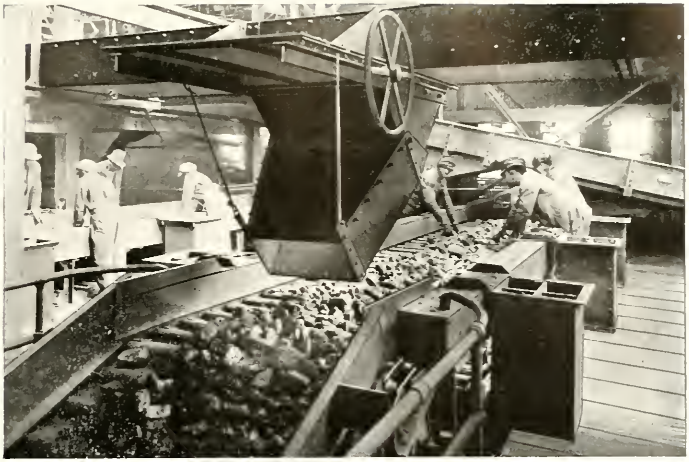
The most elaborate and expensive part of the tipple is usually the cleaning and re-screening apparatus. The small coal, usually the nut coal and smaller (coal under $3\frac{1}{2}$ inches) must be screened separately. This is screened at a separate part of the tipple. The coal is conveyed by belt conveyors or flight conveyors up to the re-screening screens, where it is divided into two or three sizes, placed in bins, or loaded directly into the cars. Where it is loaded into bins, it is usually run over smaller screens just after it leaves the bins and before it is loaded into the cars, in order to remove the last traces of small coal. Three types of re-screening apparatus are in use; the revolving screen, which is the usual cylindrical screen; the flexible hanger screen, a device patented by the Link-Belt Company, which is light, very flat, and quite efficient in handling the small coal; and the vibrating type of screen illustrated by the Hummer screen and the Link-Belt vibrating screen. Screens of the vibrating type are comparatively short and are set at very steep angles. The flexible hanger screen is of the shaking screen type, driven by eccentrics with about 6 inches travel, supported by 1 inch by 8 inch ash boards. The frame is also of ash, and all parts are so fastened together that the motion of the eccentric imparts a whip-like action to the motion of the screen, keeping the coal disturbed and increasing the screening efficiency. The vibrating type of screen runs at a very high speed, 1200 to 1800 vibrations per minute, with a comparatively small travel, possibly not over one-sixteenth of an inch. The Hummer type has a steel screen surface, strung at drumhead tension, oscillated by the motion of an electric field induced by a special generator. The Link-Belt vibrating screen is operated by an unbalanced pulley, rigidly mounted on the frame, running at a high speed. These screens are widely used in screening ore, and are now coming into use in coal screening.

The screening of the coal is always a serious problem. Practically all coal comes out of the mine with a certain amount of foreign matter in it. This



Courtesy the Link-Belt Co.

A flexible-support screen. The eccentrics and connecting rods which impart vibration to the screen are shown in the foreground.



Courtesy the Link-Belt Co.

The method of cleaning coal by hand picking is illustrated above. Chutes for discharging refuse are placed at each picking station.

may be rock or slate from the roof or floor, or there may be rock, slate, or bone coal streaks in the coal itself. Frequently, sulphur balls or sulphur streaks are found in the coal, and, where the floor is soft, dirt is often shoveled up.

The method of removal may be classified under four separate heads, washing with water, washing with air, hand picking, and mechanical picking. The most efficient system is water washing. Very elaborate plants are constructed, costing in many cases as much as one million dollars. These plants are essentially like ore washing plants in that they use water jigs and concentrating tables. However, in washing coal, the float material is retained as the cleaned coal, while the heavier material is either rejected as waste or re-treated to regain such small amount of coal as may be left in it. Such a plant, with its raw coal feeding system, jigs, concentrating table, water circulating system, elevators and conveyors for handling the various coals, sizing screens, draining conveyors, draining bins, and sludge recovery tanks, forms a highly specialized installation and one that requires a great deal of careful study and design.

The increasing demand for high grade coke and fuel has increased the use of the very delicate concentrating tables, such as the Wilfley, Overstrom, Universal, etc. This leads to the second type of coal cleaning plants, the air table plants. A concentrating table consists of a large, comparatively flat deck, set at a slight angle, rapidly oscillated by various mechanisms, the material being carried over the deck of the table by a film of water. The tendency of the motion is to segregate the heavier materials from the lighter, so that they are discharged at different points along the edge. The operation of the air table is very similar, except that the flat deck has thousands of small perforations through which air is forced, producing an air film between the deck and the coal, floating the coal on air very much as it is floated on the water and securing substantially the same degree of separation. Water separation is of much more delicate control, but in many places in the West there is insufficient water and the use of air is almost imperative. Another great advantage of air separation is the dry condition of the cleaned coal, as opposed to the very wet coal from the water washing plant. This not only yields a saving in freight cost, but it also prevents freezing. Where coal is shipped long distances at freezing temperatures, the water freezes so that it is frequently impossible to unload water washed coal without previously thawing it.

Hand picking, the third method of cleaning, is a system of picking out the refuse by hand from coal being moved in a comparatively thin stream on picking tables or circular revolving tables. The picking table is usually a steel apron conveyor. The circular revolving table is simply an annular ring, about forty-eight inches wide and possibly twenty feet in diameter, laid flat on rollers so that it can be revolved about a vertical axis. Pickers stand on the inside and on the outside of this ring. This is a somewhat simpler installation than the conveyor picking table, and it has the advantage of discharging the coal by plows at practically the same point at which it is received. The conveyor picking table, however, has the advantage of flexibility in loading the coal at various heights, with consequent avoidance of breakage, making it the favorite type in the West.

The fourth system of cleaning, mechanical picking, is also of two types, the straight chute type and the spiral type. The straight chute type usually consists of an inclined chute set at an angle just sufficient to cause the coal to flow with a reasonable velocity. Because of its roughness, the rock or dirt tends to lag. The chute has a number of adjustable gaps which the coal will jump, but in which the rock is trapped. It is a rather crude method when applied to bituminous coal. The spiral type is similar to a very large screw conveyor set vertically. The coal is discharged onto this conveyor at the top, and as it runs down it gains velocity. Here again, the rock tends to lag, so that the faster moving coal will take the outer edge of the spiral, while the lagging coal will be discharged closer to the center. The spiral surfaces are slightly warped, and a quite thorough system of adjustment of warp and angle is provided for. For dry coal, evenly sized, and with a comparatively regular type of fracture, the spiral machine is quite efficient more so in the small sizes than when hand picking is employed. None of the four systems, excepting hand picking, is suited to the large sizes of coal. Conversely, hand picking is obviously unsuited to the small sizes, for it requires entirely too much labor in proportion to the results obtained.

The immense culm piles always seen about a coal mine show the large amount of rock and refuse that must be handled. Disposal of this is frequently a problem, for it can rarely be loaded into railroad cars, taken away, and dumped. Usually some system of conveyors, skip cars, or aerial bucket tramway is demanded. The waste disposal never ceases to be a problem of annoyance and expense.

It is a general opinion that coal mining is a highly lucrative business. As a matter of fact, many mines do show good profit, but this is only by the exercise of an amount of care and effort that, devoted to almost any other line of business, would produce even greater profit. Success in coal mining requires immense investment, systematic operation, a constant vigilance for safety, and, most important of all, a sales organization that can dispose of its product so as to secure the necessary continuity of production.

THE TANTALUM ELECTROLYTIC VALVE

By

CLINTON E. STRYKER, '17

Electrical Engineer, Fansteel Products Company

THE development of a practical electrolytic rectifier using tantalum as the valve metal is the result of a great deal of experiment and study in the laboratories of the Fansteel Products Company, both on the rectifier as such and on the metal tantalum.

Tantalum is a rare metal and is extremely difficult to refine and produce in a ductile state suitable for rolling and drawing. Its outstanding properties are a high melting point and freedom from acid corrosion. Its melting point is 2770° C; its density, 16.6; its tensile strength, 130,000 pounds per square inch; its electrical resistivity, 14.6 microhms per centimeter cube at 25° C; and its temperature coefficient of resistance, 0.00335 per degree Centigrade at 25° C. It is unaffected by all acids except hydrofluoric, being immune to the effects of aqua regia.

Tantalum, along with several other metals, particularly aluminum, possesses the property of allowing electrons to flow from it into an electrolyte, but not from the electrolyte into it. This fact makes possible the electrolytic valve, one form of which is the electrolytic rectifier. The theory of electrolytic rectification has never been proven and two hypotheses are in use at present.

One hypothesis states that the rectifying film consists of a porous layer of oxide which is partly filled with gas and is impermeable to all gases except hydrogen. When the valve metal is the anode, oxygen ions will move toward it but, since they cannot penetrate the rectifying film, no current will flow. When it forms the cathode, hydrogen ions will move toward it and, since they can penetrate the film, hydrogen gas will be given off and current can flow. Since the other electrode does not form a film it does not hinder the passage of oxygen, and current can flow into the cell from it.

The other theory of rectification is that the film traps oxygen gas, which is of very high electrical resistance, and thus forms a coating of an insulating gas on the valve metal when it is the anode. On the other half of the wave the oxygen moves toward the other electrode but is not trapped. It therefore escapes, allowing the current to flow.

In either case, the formation of the rectifying film requires an appreciable period of time and there is a slight leakage of current during that time. One result of this lag in the formation of the film is that the rectifier is more efficient at lower frequencies, because the time per alternation is greater at such frequencies. As the time required for film formation is practically independent of the frequency, it is a smaller portion of the time of an alternation at low frequencies than at high frequencies. The difference in efficiency between the two common frequencies (25 and 60 cycles) is not great enough to be of any importance.

Mr. Clinton E. Stryker.

Rectification may be either half wave or full wave. In half wave rectification only one rectifying element is required.

Figure 1a shows the connections of a rectifier of this type. Full wave rectification may be accomplished by the use of two rectifier cells and a split secondary transformer as shown in Figure 1b. It will be noted that the two lead electrodes are electrically connected. This permits the construction of a three electrode cell having two tantalum electrodes and one lead electrode. This construction is being used in the full wave radio battery charger which is shown in Figure 2. Other schemes of connection are entirely feasible for obtaining full wave rectification, but the one shown is the simplest.

Where two independent batteries are to be charged, the connection shown in Figure 1c may be used. This requires only one rectifier cell for each battery and at the same time has the advantages of full wave rectification. It should be borne in mind that full wave rectification is only slightly higher in efficiency than half wave rectification, but that its power factor is very much higher. The simplicity of half wave rectifiers, therefore, usually determines their selection unless high power factor is required, or there are requirements in regard to steadiness in the output circuit, etc.

The output of a rectifier of either half or full wave type is pulsating direct current. This is entirely satisfactory for battery charging, electrolysis, and many other applications, but it cannot be used for taking the place of batteries in telephone circuits including radio plate ("B") batteries, because such service demands a continuous current. The output of an electrolytic rectifier (and some other rectifiers) can be filtered by means of choke coils and condensers to produce an output which is practically continuous current. The only limitation to the smoothing out of the output is the cost of the filter circuit. It is therefore necessary to design filters which will meet specific requirements and yet stay within the limit prescribed for the cost of the filter. A typical filter circuit is shown in Figure 3. This circuit will be described later.

In any discussion of rectifiers the question of efficiency usually causes argument because of the effect of the peculiar wave form of rectified current on various types of meters. Every electrical engineer knows that a permanent magnet instrument and an electrodynamometer instrument when connected in series on continuous current should give the same reading. This is not the case with a rectified current, for the electrodynamometer may read higher or lower than the permanent magnet instrument. A little thought will show that the difference in reading is due to the fact that the readings of the electrodynamometer are proportional to the effective (r. m. s.) value of the current, while the readings of the permanent magnet instrument are proportional to the average value. When the wave

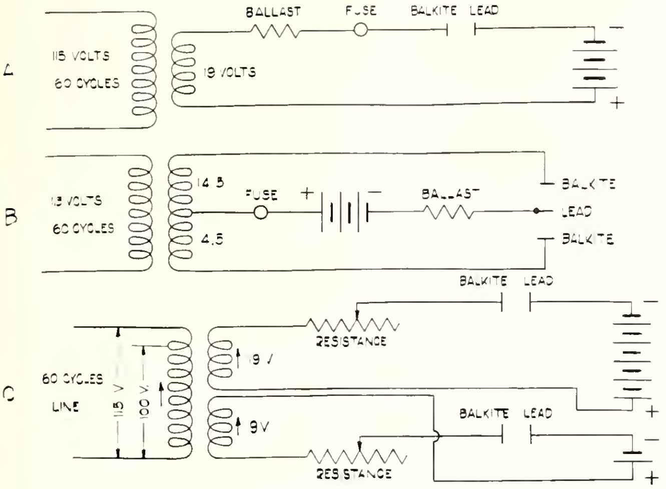


Figure 1. Connections of half and full wave rectifiers.

shape is anything but a straight line these values may be widely different.

It has been conclusively proven that electrochemical effects are proportional to the average value of the current. This dictates the use of permanent magnet instruments where electrochemical work is being done by the output of the rectifier. Theoretically, the output of rectifiers could be measured with a wattmeter but practically, such instruments are affected by changes in wave form and therefore sometimes give erroneous readings. The power input to the device, being alternating current, must be measured with a wattmeter and the volt and ampere input, for the same reason, should be measured with meters giving effective values. The efficiency of a rectifier is equal to the output voltage times the output amperage divided by the input in watts, all measured as described above. The power factor concerns the input only and is the input in watts divided by the input volt-amperes.

The effectiveness of rectification is expressed as the ratio between the d-c. current output and the a-c. current input to the cell. Since the input and output circuits and the cell are all connected in series, it is possible to connect an electrodynamometer and a permanent magnet ammeter in series anywhere in the line and get this ratio. It will be equal to the reading of the permanent magnet instrument divided by the reading of the electrodynamometer instrument. If a rectifier circuit is open on the output side, that is, if it is not connected to any load and no filter is interposed in the circuit, a d-c. voltmeter connected across the output terminals gives a reading which has no particular relation to the output voltage of the rectifier under normal conditions of use. This is because of the wave form of the rectifier under no-load conditions. The output voltage should only be measured under normal conditions with the load and filter connected.

The electrolytic rectifier has always been a fascinating subject to the electrical engineer and a great deal of work has been done to develop it. For many years this work did not produce a satisfactory device, on account of the inherent defects of aluminum as a rectifying electrode. The two principal defects of aluminum are the instability of the rectifying film and the high resistance of the electrolyte. Aluminum has been tried in acid electrolytes but their corrosive action on the electrodes is so rapid as to make such a combination impracticable. It was therefore necessary to use various alkaline electrolytes in order to obtain even a fair life of electrodes. All such electrolytes have high electrical resistance and slowly attack the aluminum. The most serious effect of this attack is the decomposition of the rectifying film. This film is eaten away in periods of idleness and it is necessary to re-form it whenever the rectifier is used. In some applications which require instantaneous d-c. this is a serious defect. The advantages of the aluminum rectifier are its low cost and the relatively high voltage which the film will stand. For example, an aluminum rectifier can be used in series with a resistance to charge a battery from the 115 volt a-c. lighting circuit whereas this cannot be done with a tantalum rectifier.

Tantalum has many desirable characteristics as a rectifying electrode. It is immune to acid corrosion and can therefore be used in acid electrolytes of low resistance. Its rectifying film is permanent and forms almost instantly the first time current is passed through it. Once formed, it can only be removed with great difficulty by the use of a mixture of hot nitric and hydrofluoric acids. The permanent character of the tantalum rectifier places it in a class by itself and makes of it a thoroughly dependable electrical device. The cost of tantalum is greater than that of aluminum, but it is doubtful if it is as expensive in the long run. If dependability is required, the tantalum rectifier is the only one which can be used. The breakdown voltage of the tantalum rectifying film is lower than that of aluminum. Tantalum and aluminum rectifiers exhibit quite different actions near the critical voltage. An aluminum rectifier, on being brought up to the critical voltage, gradually begins to leak and finally breaks down completely. This

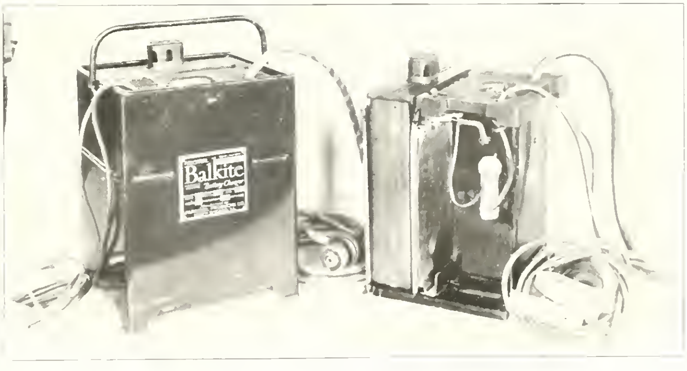


Figure 2. A full wave radio battery charger.

makes it inefficient on voltages somewhat below the breakdown voltage. The tantalum rectifier, on the other hand, has practically no leakage until breakdown occurs. This breakdown is accompanied by arcing which burns the tantalum electrode. The approximate voltage limitations are as follows: when used as a check cell to prevent the flow of direct current, 60 volts; when used to furnish d-c., but not for charging batteries, 40 volts a-c. input which when properly filtered will give about 30 volts d-c. output; when used for charging batteries, not more than 10 cells (20 volts). The reason for the last limitation is that on the reverse half of the cycle the rectifying film must withstand the a-c. voltage plus the battery voltage.

The commercial tantalum rectifier uses electrodes of tantalum strips and cast lead in an electrolyte of sulphuric acid, to which is added a small quantity of ferrous sulphate. A small quantity of light pure paraffin oil is poured on top of the electrolyte. This forms a film which traps the gas bubbles and minimizes the acid spray which the gas would otherwise produce. Since the specific gravity of the acid is of no particular importance, it is customary to use the same value as is used in the batteries which are to be charged. For example, 1.220 acid is used in rectifiers for railway battery charging and 1.250 for radio rectifiers. Those of the higher values have several minor points of advantage in that they freeze at lower temperatures and do not evaporate so readily. Freezing does not seriously affect the rectifier unless it does mechanical damage to the cell. If a voltage is applied to a cell which has frozen to slush (this is the manner in which acid electrolytes freeze) rectifying action begins immediately and the electrolyte is soon melted by the heat generated as a result of current flow. Balkite rectifiers have operated at temperatures as low as 30 degrees below zero (Fahrenheit) and as high as the boiling point of the electrolyte.

The most common use of rectifiers is for charging storage batteries. Small storage batteries have many applications, such as in radio, automobiles, time clocks, railway signals, etc., and it is ordinarily very desirable to have a small charging unit to charge them individually. It is in service of this kind that a rectifier fills a great demand. In many instances, it is desirable to charge the battery while it is in use—in other words, to float the battery. A rectifier which can do this is very desirable. Rectifiers find another application where direct current is wanted without the use of a battery. In some cases, this current can be pulsating, as, for example, in electroplating and in operating various magnetic devices. Very often, however, the output must be a truly continuous current as for radio plate current supply and similar applications. There are also uses where a substantially continuous current is satisfactory and where filtering need not be complete. Such applications include the operation of electric clocks, telegraph sounders and telephone selectors.

Perhaps the greatest use of rectifiers, in point of number, is for charging radio "A" batteries. The Balkite Model "H" charger developed for this purpose is shown in Figure 2. It consists of a full wave rectifier cell with two tantalum electrodes and one of lead, a transformer for reducing the line voltage to a voltage suitable for charging batteries, a ballast coil to maintain the charging rate at a reasonably constant value with variations in line voltage, a fuse to protect the device, and suitable leads and attachment devices. The cell is of hard rubber and the outer enclosure is of terneplate (lead-coated steel). This charger is intended to charge 6-volt storage batteries. Its principal characteristics are:

Charging rate	2.5 to 3.0 amperes d-c.
Primary volts	115
Primary cycles	60
Primary amperes	0.6
Primary watts	60
Secondary volts (at full load)	14.5-29.0.
d-c. a-c. ratio	0.78
Efficiency	25%-30%
Power factor	85%
Net weight	14 lb. or 6.1kg.

This charger can be used to charge the battery while the radio set is in use, without causing a disturbing hum except in a few very sensitive sets (sensitive to battery disturbances, but not necessarily to signals). In the case of such sets, it is possible to minimize the hum by the use of a choke coil connected between the battery and the set. The charger will not burn out the tubes even if the battery becomes disconnected and, since the secondary of the charger transformer is completely insulated from the primary, there is no possibility of the line current affecting or endangering the set.

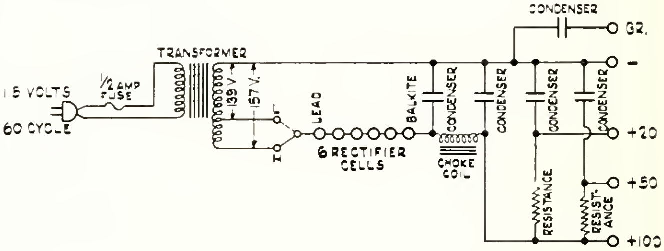


Figure 3. Rectifier with filter and connections.

A radically different type of service is that of charging railway signal batteries. These batteries are installed at signal locations along the railway line and must, therefore, operate with a minimum of attention. Reliability is paramount in this service and there should be nothing in the charger to get out of adjustment. The Balkite rectifier for this work consists of a transformer which is ordinarily mounted in the relay case and either one or two rectifier cells which are placed in the battery well or compartment. The whole device is constructed in accordance with the American Railway Association standards and is very rugged. The most commonly used rectifier operates from a 115-volt, 60-cycle line and has a 100-volt tap to take care of low line voltages. It will charge a five-cell and a one-cell battery, each at one ampere. The battery circuits are entirely independent, as shown in Figure 1c. If only one battery is to be charged, one half of the rectifier is used. The charging rate is varied by means of adjustable resistances. These rectifiers are always used for charging the battery while it is in use. They operate continuously, the idea being to put in a continuous, low-rate charge which will make up for the demands on, and supply the internal losses within the battery. The rectifier cell is large in volume in order to hold enough electrolyte to make renewal of the water necessary only at long intervals. This cell will operate at a one-ampere rate for over 200 days before addition of water becomes imperative. The rectifier is not damaged if allowed to run until enough water is used up to cause the electrolyte level to fall below the bottom of the electrode but

(Continued on page 73)

HEAT-TREATMENT OF HIGH-SPEED STEEL

By

W. H. WEINWURM, '25

HIGH-SPEED steel is an alloy tool-steel whose essential alloy is tungsten. The average grade of steel contains 16 to 18 per cent tungsten, 3.5 per cent chromium 1.25 per cent vanadium, and carbon from 0.60 to 0.80 per cent. High-speed steel derives its name from the fact that cutting tools made from it may be used at high-speed, the heat produced in cutting not affecting the temper, although the cutting edge may become red hot. This is called red hardness, the characteristic of high-speed steel.

Robert Mushet, an Englishman, was the first one to demonstrate the red hardness in an alloy steel containing tungsten. Two American metallurgists, Taylor and White, developed the high-speed steel of today and demonstrated its heat-treatment at the Paris Exposition in 1900, where the practical cutting tests proved a revelation. Their heat-treatment consisted in heating the tool to a white heat until the metal at the surface was ready to flow, the tool then being quenched in a bath of molten lead, afterward being removed and cooled in a bath of oil.

One can readily understand the importance of the development of high-speed steel, since previous to its introduction carbon-steel tools were used exclusively. The cutting edge of the latter becomes soft when the heat produced by cutting exceeds 400 to 450° F. On the other hand, with the heat-treatment of today, a high-speed tool will hold its edge although the heat generated in cutting reaches 1100° F. The result is that machines operating with these tools have increased efficiency, greater feeds and speeds being employed.

The development of the automotive industry was concurrent with that of rapid-cutting tool-steel. In fact it may be stated that without the aid of high-speed steel, the production of automobiles on the vast scale of today would be an impossibility.

As was previously stated, this steel is an alloy steel; however, it is further classified as a complex alloy. It has always been found that the more complex the alloying of steel for tools becomes, the more hazardous is the hardening operation. Therein lies the prime necessity for a well balanced raw steel, free from segregation of the alloying elements, to insure a lessening of the hazard of cracking in the hardening process.

Mr. Walter H. Weinwurm.

High-speed steel is manufactured by the crucible process or in the electric furnace. In the former process the alloying materials, pig iron, scrap, and the correct proportion of carbon, are placed in the crucible, a cover is sealed on, and the crucible is then placed in the melting pits. These are usually gas fired, four or five hours being sufficient to produce a molten mass of uniform composition. The contents of one pit, usually about fifteen crucibles, are emptied into a large ladle to insure a steel of average composition. From this ladle the ingots are poured.

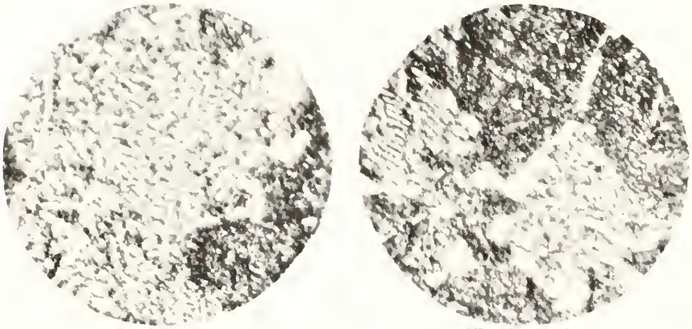
The rate of cooling in the ingot must be carefully controlled. Too slow cooling causes segregations of the type shown in microphotographs numbers 1 and 2. Here the white bands or network of tungsten have settled from the heterogeneous mixture, the steel being weakened and subject to failure along these lines of least resistance. Too rapid cooling causes gas inclusions and pipes. An example of this condition is shown in illustration number 3. This picture was taken under low magnification along a pipe in a 6 in. x 1/8 in. bar. The white blotches are the alloy; the dark, the blow hole. To eliminate the piping a riser or hot top is placed on the mold. After it is cooled this is cropped off and the ingot further worked into billets.

These are then cogged, a term for the mechanical working under the steam hammer to break down the large grains and to disseminate the alloys uniformly throughout the billet. The cogging operation is followed by a further reduction in area in the rolls. High-speed steel requires a great deal of mechanical working. This reduces the hazard of failure when heat-treating the finished product, for this working breaks down the transverse formation of the crystals due to the slower rate of cooling in the center of the ingot.

At this date a common practice in production tool work is the working of the steel into small forgings approximately the size of the tool, allowing for finish. This eliminates the cutting from the bar stock and furthermore by the forging, a more uniform steel has been produced. These small forgings are easily worked, the grain size being reduced an appreciable extent, giving the steel better wearing and cutting qualities.

In the aforementioned mill practice the continued reheating and working introduces strains and grain growth within the steel. To eliminate this the steel undergoes a normalizing process. The operation consists of heating to 1750 F., holding for several hours, and cooling. This is repeated, the temperature being reduced one hundred degrees each operation until the regular annealing temperature, 1450 F., is reached, at which point the temperature is held six hours and then lowered. To prevent scaling and decarbonizing on the surface, the bars before being normalized are packed in pipes which are then filled with charcoal. After this operation the steel is inspected and placed in stock.

This steel is consumed in the production of tools. These are usually of intricate design, such as gear-cutting hobs and the like, involving a great deal of labor in their production. The steel itself, at present market prices, ranges from fifty cents to one dollar per pound. Therefore the tool manufacturer subjects the raw material to a rigid inspection. The steel is analyzed and must fall within a very narrow range on specification. Furthermore, test pieces are taken from every bar received and a grab sample from the smaller forgings, which forgings are then subjected to the regular heat-treatment. These test pieces then undergo examination as to fracture and physical tests. The most exacting physical test is the study of the structure of the steel under the microscope.


Microphotograph 1. Microphotograph 2.
Segregations of tungsten in high-speed steel.

The condition of the steel can best be studied under the microscope after the specimen has been hardened. In microphotographs numbers 1 and 2 the segregated network of tungsten can be seen. These photographs were taken midway between the center and the outer edge of a 7 in. x 1/8 in. bar of high-speed steel. This type of structure is termed a cast ingot structure. Number 4 is a structure showing uniform distribution throughout.

Even with the above precautions, tools fail because of poor steel. One end of the bar from which the test specimen was taken may have been excellent while the other end may have had a flaw running but a few inches, although great enough however to have caused the failure.

The steel which passes this preliminary inspection is entered into production. When the heavy turning or milling operations have been completed the tool is annealed to remove the strains introduced by these operations, and is then finish machined, after which it is hardened. If the tool is of intricate design subject to distortion, the density of the steel is increased by a preliminary hardening and annealing. It is then finish machined and hardened.

In hardening high-speed steel the use of three furnaces is standard practice. The tools are first placed in a furnace, called the first preheat, whose temperature should not exceed 1425° F. Here they are allowed to remain until by the color of the tools it is seen that they have a uniform heat throughout, and are up to the furnace temperature. The tools are then moved to the second preheating furnace, whose temperature should not exceed 1600° F. Here they are again allowed to remain until the temperature of the tool is that of the furnace and is uniform throughout the piece. The uniformity of the color of the tool at this point is of utmost importance. A slight excess of gas to insure a reducing atmosphere is always maintained in the preheating furnaces to prevent excess scaling of the tools.

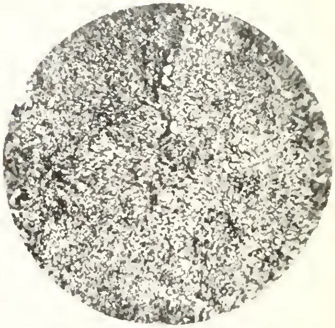
From the second preheating furnace the tool is transferred to the high-speed furnace. This is a well-insulated gas-fired furnace whose temperature is maintained at approximately 2300° F. The temperature is varied depending entirely upon the size of the tool entered, and the amount of heat it will take from the surroundings on entering. The operator, or hardener, turns the tools intermittently to insure an even heat. The hardener gauges the tool with his eye and when it reaches the temperature of the furnace it is taken out and quenched in a bath of oil. To eliminate the personal equation to some extent, each furnace is equipped with a pyrometer, which aids the operator in gauging the temperature.

Microphotograph 3.
Pipes and inclusions.

Theoretically, the preheating allows the molecules within the steel to rearrange themselves slowly, the rapid absorption of heat from 1600 F. to 2300 F. puts the alloys in solution, and the quenching operation holds the alloys in solution. The steel after quenching is too brittle to be of use, so to remedy this it is tempered.

Tempering is the introduction of sufficient heat into the steel to allow the molecules to readjust themselves. In tempering, some of the alloys come out of solution. High-speed steel is tempered at 1050 to 1100° F. Usually in a bath of molten saltpeter or by any other method where uniformity of temperature is controllable.

The next operation following tempering is the removing of the scale produced in hardening. This is done by sandblasting. For fine parts the tools are preferably pickled in an acid solution. When the scale has been removed the tools are inspected. The file is of great assistance to the hardness inspector. By means of it, an experienced man can tell whether the tool is brittle, hard, soft, or tough. However, the more accurate methods used in inspection include the use of testing instruments such as the scleroscope, Brinell, and of late, the Rockwell testing machines. The tools are always inspected for visible defects such as cracks, seams, and the like, which appear after hardening. This finishes the heat-treatment of the tool and it is then put to work.


Microphotograph 4.
Uniform structure in hardened high-speed steel.

OLD CIVILIZATIONS AND OUR OWN

PART II

By

E. O. PIERCE, '24

LET us now attempt an interpretation of our historical outline. In the first place, divesting ourselves of all idealistic prejudices regarding the inherent characteristics of the genus homo, man is first of all an animal. This cannot be denied, and there is no use hoping that the future will ever make him other than basically animal. As such, his principal activity always has been, is now, and always will be the satisfaction of material wants. Stated differently, his first and most important activities are economic in character.

Now the inherent overwhelming desire to gratify wants is not criminal, ignoble, or even wrong. We have even defined progress in terms of the satisfying of wants. True, we included other than material wants, but the latter must be gratified first, and the energy which may be expended in the gratification of the so-called "higher wants" is that which remains. After providing sufficient food and clothing for himself and his children, the working man will want more and better food, clothing, and lodgings, a telephone, an automobile, and so on—indicating a progressive taste which is in itself cultural. But he will also want his children to go to college, to study science, music, art; "to have, to know, to do."

This prepares us to formulate our second law of progress, namely, *the advancement of society is dependent upon its economic development.* But social progress is not identical with economic development. The latter bears an organic relation to the former which the part bears to the whole. Now contemporary civilization is without a doubt economically highly developed. Therefore the potentiality exists for an advanced civilization. That is, all that is required in order that we may progress in all lines, is time and the retention of the advantage which we already have. *Contemporary civilization should be preserved.*

We have established that the progress of society is dependent upon its economic development. Why, then, the fall of Rome, of Carthage? Wherein lies the danger of an economic civilization, which seems to have caused the decline of these nations? From our theory of social evolution, the fall of a particular civilization would connote a lack of adaptation on the part of that civilization. But wherein does this lack of adaptation occur?

Let us go back to our definition of progress. Since we have shown that social progress depends upon economic development, it must be that in the cases cited, economic development in the highest degree *for the largest number of people* did not take place. And this is exactly what our historical outline has indicated, namely, that the gulf between poor and rich widened rapidly, that the bulk of wealth accumulated in the hands of a few, and that this accumulated power was horribly misused further to restrict the distribution of wealth. The principle to be obtained from this is that *social progress cannot take place unless economic progress affects the bulk of society.* Stated differently, constituting our "law of decay," *if economic progress affects a minority of society, that society cannot endure.* And not only is this true, but when *any* section of society is deprived of its rights, or of its entire freedom of action, society as a whole is deprived of part of its propelling power. Slaves, industrial or otherwise, have no ambition, no incentive, no capacity, for invention, production, betterment; they lack education, experience, time, and surplus energy.

To this point we have found that social progress is the result of social evolution and that the great evolutionary forces can and should be studied and adapted to; that we can and should preserve our civilization. We have studied the history of numerous civilizations and have unearthed a connected series of corresponding phases in all, which we may term a "theory of civilization." From the latter we have determined a law of social progress, and a law of decay—telling us what, principally, to avoid if we desire to preserve our civilization. Our next duty is to determine whether our civilization has anything that the older civilization did not have, which if properly availed of will enable us to avoid the disasters which befell the old.

It has been possible to arrive at a consistent and logical series of connected phases in the histories of all civilizations, because we were considering *all* civilizations and because our process was a synthesis—because the same tendencies permeated all civilizations and the lack of a particular example in one civilization could be supplied by another. Our reasoning was inductive. The problem which now faces us is to select *particular* phases in which our own (particular) civilization differs from *all* others. And this is a most difficult problem because of the complete absence of records of accurate, detailed, and general surveys. Can we say, for example, that our present general average of intelligence is greater (or less) than that of the Athenians at the time of Pericles? Are we more (or less) moral than the Romans at the time of Nero, or the Hebrews at any period in their national history we care to name? Are the people of Illinois and Michigan, in this year A. D. 1924 any more moral, intelligent, cultured, civilized, than the people of Iowa and Wisconsin? Instead of dissimilarity between our civilization and other civilizations in a similar period of their history, we find, in the absence of detailed statistics, a remarkable degree of similarity. It is simply impossible from the meager material available to select any preponderant difference between our own civilization and other civilizations, broad enough in its application and deep enough in the social organization of things, to provide means for such a world-moving force as we require for the preservation of our civilization. However, this infinite social force for which we search does not have to obtain its existence from some *difference* between our civilization and the others. Other civilizations may have had conditions identical to ours. And the same means which would have preserved other civilizations might preserve ours. In fact, it is our contention that the principles which we are evolving have been *known and* probably fully *understood for centuries*—they merely have not been used. But this will appear later. For the present, we have evolved our laws of social progress and decay. They are laws which involve forces far from superficial, periodic, or restricted—amply competent, if anything is, to accomplish the desired result. Let us make use of these laws.

In the first place, if we are to escape the inevitable consequences of the operation of our law of decay, we must provide a means of making economic progress affect a majority, of making wealth the servant of all people. An equitable distribution of the results of production and increased productivity must be made. Every man must have an equal chance to win for himself the good things of life. Society must not be divided into a class that rules and a class that is ruled, perverting religion, education, law, and science from offices of elevating man into instruments for keeping him down. Real equality of rights must exist between men and before the law, as before God; men must stand on what they are, not what they have. In other words, we must return to the principles which underlie the teachings of the three greatest religions the world has ever known—Christianity, Buddhism, and Confucianism—which have been *known and understood for centuries*, and the bona fide application of which would preserve any civilization. "As ye would that men should do unto you, do ye even so unto them." This does not mean "socialism" as our readers have no doubt feared, for socialism assumes a change only in society as a unit; the principle above requires a change in the individual. It means an "auto-evolution" of the good inherent in every human being, of the true sense of equality and fairness which exists, behind the vanity and avarice, in the heart of every human being.

The intellectual classes, so called, of our civilization, cannot accomplish this alone; neither can the government, nor the wealthy, nor the poor, nor any restricted agency or group. We must gain the cooperation of everyone.

"It's the everlastin' teamwork of every bloomin'
Soul that wins the race."

How may we secure this cooperation? Set interest going! Make every man, woman, and child acquainted with the facts, together with his duties and responsibilities. This mean widespread *education*—not education to suit the educated, or the parents, or the politicians, or the newspapers, or "the powers that be," but education to suit the *facts*. And when we think of educators, we think not only of school teachers, but of preachers, writers, and publishers—in a word, all who may influence the public mind.

How may we determine these facts from the present muddle of opinion? Opinions will undoubtedly always rule the decisions on many social problems; and therefore the general level or value of these opinions must be raised—which means general *mass education*. Another means would be to provide, say a committee of experts (we have had too much botch-work by non-experts) government supported, the duty of which would be to give scientific advice on social problems, matters of government, and so on, and to give widespread publicity to expert opinions on mooted questions involving in any way the integrity of the race or the nation. Such an organization should not be subject to political or other influence. Its membership might possibly be elected from the memberships of the various professional societies and to hold such an office might well be made to become the highest professional honor. Such a committee would consider and make public, opinions upon matters involving problems of social adaptation, race problems, the tariff, birth control, and a hundred others.

Armour men have had an important and responsible share in the growth of that infant giant, radio telephony. Among the foremost of these is Mr. Edward L. Nelson, of the Class of '14, who is in charge of the development of transmitting equipment at the laboratories of the Western Electric Company in New York City. Mr. Nelson has prepared for the March issue of THE ARMOUR ENGINEER *a comprehensive, thoroughly readable, and intensely worthwhile article on Transmitting Equipment for Radio Telephone Broadcasting. Radio fans, and all other readers of* THE ARMOUR ENGINEER, *are cautioned not to miss this delightful treat.*

What has been the part of the engineer in the building of ancient and modern civilizations, and what shall he do to aid in preserving that for which his labors have been so essential in winning for the human race?

We have seen that every material adjustment involving brain processes is socially evolutionary, as well as every non-material adjustment. We have also seen that these material adjustments have in nearly all cases been the result of the work of many minds rather than that of a single mind. And who have been the possessors of these minds but engineers—men who put into practice for the benefit of humankind the principles of science? This is the general case of the engineer and civilization as a whole. But the engineer has also provided means whereby individual civilizations or nations have had prolonged life, or have been made preeminent in history. Engineers built the pyramids. Engineers provided the means of transportation of stores, and built the bridges whereby the conquests of Alexander were made possible. Engineers built the great wall of China, restricting the inroad of barbarians. Engineers provided the rams by which the great Persian fleet was slaughtered by the Athenians at Salamis; the means of circumventing these rams at Economus, leading to the destruction of the Carthaginean fleet by the decidedly inferior Roman forces; and the iron clad Monitor of the Civil War was another product of engineering evolution. Engineers built the aqueducts by which it was possible that the great City of Rome could expand from a little barbaric village; and engineers built the roads which made possible the conquest and government of the Roman Empire, the greatest empire of all time.

Now let us again consider the general phase of the matter. We have shown that social progress is a function of economic progress, and we know how inextricably is modern economic progress bound up with engineering progress. Transportation, rapid communication, quantity production, and other major factors in our economic life are products of engineering. It seems entirely logical to say that with all the accumulation of the profits of productivity in the hands of a relatively small group, productivity has undergone such a tremendous increase due to engineering activity during the last century, that even the lower classes of society have received some small benefit from our economic progress. In this way, the engineer has been the instrument by which social decay has been postponed. In the continuation of this work, he may postpone this decline still further. Also, through his training in dealing with facts as facts, he should be among the first to realize the exigencies of the present social emergency, and the means to avert the decline of our civilization. He should then bend his efforts toward the preservation of our civilization by taking an active part in effecting the necessary reform and restoration.

To summarize, our solution of the problem, "How can our civilization be preserved?" is merely to make use of the *scientific information we have available*, and to *spread this scientific information by means of mass education.*

Thus stated, the solution seems quite simple. But from a practical viewpoint, it sometimes seems doubtful, as we look around us, if it will ever be put into effect. However, we can but be optimistic. In the words of Professor Conklin of Princeton, "In the present conditions and tendencies of the human race, in the contest between progressive and retrogressive forces, we see much cause for anxious concern, but thinking on the distant past and the boundless future creates a feeling of detachment and of philosophic calm like that of the dwellers on Olympus. We cannot see clearly the next scene, we can scarcely imagine the next act, and the end of the Great Drama of Evolution, if there is to be an end, is a matter of faith alone."

"O, yet we trust that somehow good
Will be the final goal of ill,
To pangs of nature, sins of will,
Defects of doubt and taints of blood."

THE ARMOUR ALUMNUS

PROF. J. C. PEEBLES, *Editor*

In the last issue of the Alumnus we presented a brief sketch of the career of **R. M. Henderson, '02,** our first alumni member of the board of trustees of A. I. T. At the time of Mr. Henderson's election an advisory committee of five was also appointed to consult with the alumni trustee in matters in which the Alumni Association is particularly interested. The members of this committee are as follows:

John J. Sloan. Mr. Sloan was a student in the early days of Armour Tech, specializing chiefly in chemistry. He has had a wide experience in business and in engineering and will make a valuable member of the advisory committee. He has become well known to the public through his activities as president of the Board of Local Improvements, a position which places him in charge of all street widening, paving, sewer, bridge, and similar work in the City of Chicago. He has a comprehensive grasp of the intricate problems of city building, problems which are chiefly engineering in their nature. Mr. Sloan will be a valuable man on this committee; for, although a very busy man dealing with large affairs, he is much interested in A. I. T.

Alfred S. Alschuler, '99. Mr. Alschuler needs no introduction to Armour men. He has always taken an active interest in the affairs of the Alumni Association and the Institute, and we know that this interest will continue on the advisory committee. Anyone having even a casual acquaintance with architectural work in Chicago and vicinity has heard of Alfred Alschuler. He has been engaged in this work for more than a score of years in Chicago, and now occupies a position in the front rank of his profession. Much of the splendid work which is being done to improve our city through the erection of beautiful buildings is due to the genius of our Chicago architects. In this work, Mr. Alschuler has had no small part.

Bertrand G. Jamison, '97. Mr. Jamison is a member of the first class graduated from Armour Tech, and for twenty-seven years has been one of our most loyal alumni. He is an engineer for the Commonwealth Edison Company, Chicago, his work being chiefly with the power plants and other mechanical equipment of the company. Mr. Jamison is an engineer of long experience, well qualified to advise with the alumni trustee in matters affecting the training of young engineers.

William Fargo Sims, '97. Mr. Sims is also a member of the first graduating class, and an engineer for the Commonwealth Edison Company. It is gratifying to note that men of wide experience and heavy responsibilities are giving of their time and energy to promote the welfare of Armour Tech. Such men as Mr. Sims are needed in any alumni activity, particularly when it concerns the governing body of the Institute.

Charles W. Hills, Jr. Mr. Hills is a patent attorney who enjoys an extensive practice in a branch of the law very closely related to engineering. He is an active member of the Alumni Association, much of the success of recent alumni events having been due to his efforts. He is a hustler who puts "pep" into everything with which he is associated, and we know that his influence will be felt for good on the advisory committee.

MID-WINTER BANQUET

The annual mid-winter banquet of the Armour Alumni Association will be held at the Auditorium Hotel, Chicago, Wednesday, January 21, 1925, at 6:30 p. m. Notices will be sent out by Secretary R. A. Goppelsroeder, to all whose names and addresses are on our mailing list. A strong effort will be made by the committee in charge to make this event the best ever held by the association. Those who attended the spring banquet last May will recall that this was the largest in point of attendance that we ever had. Efforts will be made to raise the record still higher at the coming affair, and the support of every alumnus is urged and expected. As soon as you receive your notice from the secretary, send back your acceptance promptly and so minimize the worries of the committee and the secretary. The Alumnus knows something about the worries of the secretary, having served in that capacity more than once. We are glad to say a word in his behalf.

Intercollegiate Glee-Club Contest

The annual intercollegate glee-club contest participated in by mid-western colleges and universities will be held at Orchestra Hall, Monday evening, February 23, 1925. Our glee club is entered in the contest, and is working hard in preparation for the event. All alumni and former students of Armour Tech are urged to come out on this occasion and give the musical clubs generous support and an enthusiastic reception.

The Alumnus regrets to report the death of **Royal A. Chappell, '18,** who passed away at his home in Grand Rapids, Michigan, November 30, 1924. He is survived by his wife and daughter. The deceased was a member of the Delta Tau Delta fraternity and very active in institute and fraternity affairs. He was a talented musician and wrote the music for the Junior class play presented in 1917.

L. E. Grube, '24, was a recent visitor at the Institute. He has recently joined the ranks of the benedicts, is living in Sheboygan, Wis., and is engaged in the building material business.

Three of the 1924 men, **E. L. Carlson, T. E. McDowell,** and **L. L. Swartz,** are with the Illinois Bell Telephone Co.

J. W. Falconer, '24, is with the Edison Storage Battery Co.

Stanley Farrell, '24, is with the Illinois Appraisal Co., where he finds what a lot of money the engineer spends when he builds engineering works.

J. O. Aalberg, '24, is projection engineer with the Madison Theatre.

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"I'LL TELL THE COCK-EYED WORLD!"

It is just three weeks until Commencement, and a group of Seniors is gathered in the senior drafting room discussing the approaching event. They can hardly wait for the great day to come when they will burst forth on a breathless and waiting world. Anyone asserting that this is the best class ever graduated by Armour Tech has no chance for an argument; they all admit it. There is no braggadocio among them, however—simply a modest recognition of conscious superiority.

Most of the Seniors are on the lookout for a *situation* to step into immediately after graduation, some are looking for a *position,* while a few will be satisfied with a *job.* One young man whose record during the past four years, as shown by the books in the Dean's office, is nothing to get excited about, has his eye on a possible situation. His prospective employer, however, evidently considers it a job, for the salary offered is just $100 per month. A classmate asks if he intends to accept this offer. "I'll tell the cock-eyed world I won't; nothing less than $150 gets me, and I won't work long for that!"

Why is this big, busy world so interested in this young graduate about whom it knows so little? Why is it so cock-eyed with anxiety as to how much it will have to pay to secure his services? Perhaps it isn't.

In one of the class rooms in Machinery Hall, several students have lingered after the close of the lecture. The professor has been discussing the development of the steam turbine as a central station prime mover, and has pointed out the striking increase in the size of the units which has taken place in the last few years. The students are wondering if this development will continue, resulting in bigger and still bigger turbines. One of their number, who flunked his last quiz, has a positive opinion on this question. Although the basis for his opinion is not readily apparent, he does not hesitate to express it. "I'll tell the cock-eyed world that we will have bigger turbines. The time will come when turbo-generators will be so large that one of them could furnish light and power for the whole of Chicago."

Why does the world care so much about this embryo engineer, that he finds it necessary to broadcast his opinions on a subject about which his knowledge is 1 1? Perhaps it doesn't.

It is just 12:20 o'clock and streams of students are issuing from the different buildings and hurrying towards the lunchroom. In front of the main building a large touring car is waiting, in spite of the fact that adequate parking space, off the street, is provided elsewhere. The bumper has a kink in it, one lamp bracket is bent, and a fender is badly crumpled, all mute evidence of careless or incompetent driving.

A dozen students make a rush for the car, piling in on top of each other. The

(Continued on page 62)

THE ARMOUR ALUMNUS

(Continued from page 61)

From the *American Gas Association Monthly*, we note that **H. C. Abell, '04**, has been elected president of the association. He has long been active in public utility matters, has been a director of the American Gas Institute, and has served the American Gas Association in a variety of capacities. We are pleased to record his election as president of the latter organization.

"I'LL TELL THE COCKEYED WORLD!"

(Continued from page 61)

driver starts the motor, opens the cutout, and goes roaring down Thirty-third Street amid a cloud of smoke and gas. Dr. Raymond is attracted to the library window by the noise, just in time to see the car dash between a motor truck and a street car and then disappear beyond State Street. The president is evidently speculating on the irresponsibility of youth, and his face clearly shows his displeasure.

Youth lives largely in the future, yet there is something peculiarly atavistic about it. Ten years ago this same demon driver was a cliff dweller, spending hours of his playtime in a cave which he and his playmates have dug; eating potatoes, half baked and half burned, and going home at night with eyes smarting from smoke, to complain of his mother's cooking. Or perhaps he was a bushman, spending his leisure in a crow's nest which he has built in a tree. But today he is a Roman conqueror, tearing through the streets in his chariot. The students on the sidewalk are the admiring populace, come out to do him honor, and they must be properly impressed. No matter that the chariot shows evidence of inexpert handling; no matter that the driver mistakes noise for power. "I'll tell the cock-eyed world that this is some car and I'm some driver!"

Why is the world, which was building cars when this boy was playing marbles, so interested in this amateur race driver, this lad with the light head and the heavy foot? Why is it so anxious to hear the roar of his cutout or smell the smoky, half-burned exhaust? Perhaps it isn't.

At a meeting of the Alumni Association a number of old grads have collected in a corner and are swapping experiences. One man has made an outstanding success as an automotive engineer and the others are questioning him in regard to the probable future of the industry. They want to know if the automobile is approaching its ultimate development, or if radical departures from present practice may still be looked for. "Frankly, gentlemen, I don't know. Minor refinements and improvements will of course be made from time to time, but revolutionary changes will depend very largely upon what the public wants. We have our ears to the ground; we'll listen to the world."

Another man in the group is a representative of an American manufacturer doing a large foreign business, particularly in South America. He is asked about the future of American foreign business; whether we can build up sufficient export trade to supply a substantial outlet for our manufactured products. "Much depends upon the tact and adaptability of American business men and engineers. Business methods in South America are very different from our own; we must do business their way, not our way. There is too much tendency among Americans to tell it to the world; not enough willingness to listen to the world."

The student just leaving college and entering upon his life work, *must* tell it to the world. The man of experience, at home and abroad, finds it wiser to listen to the world. Youth is full of enthusiasm, of self-sufficiency, of cock-sureness, and he must let the world know. Later he finds that much of what he knows isn't true, and he begins to tell less and listen more. He loses his cock-sureness and his self-sufficiency is displaced by a desire for co-operation with others, but if he has the right kind of stuff in him he will retain his enthusiasm. Tempered by experience, aided by the co-operation of his fellows, and carried forward by enthusiasm for his work, he may reach a point where the world will listen when he speaks.

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EDITORIALS

TECHNICAL EDUCATION

Technical education is intended as a training in the arts and sciences that underlie the practice of the trades or professions. Engineering education, therefore, in a narrow sense should deal with those forces of nature which are to be utilized for the benefit of mankind. But in a broader sense, most important of all is that phase of training that develops the engineer to the highest point of efficiency as a citizen and a member of society.

The first part of the program is pretty well carried out by the engineering colleges. Indeed it may be fairly questioned if it is not being overdone, judging by the crowded curricula of these schools and it may be questioned too if the average student can assimilate all that is handed out to him in the four years of undergraduate study and practice. All of the study and practice of a lifetime will be without avail unless and until, when given the opportunity to engage in engineering, the individual develops aptitude and love for the work. Without these qualities he becomes a mere hackney. But whether a success or failure professionally it is incumbent upon every educated man to become a useful citizen. And this brings us to the second part of the program.

Do engineers as a class attain to the highest degree of efficiency as citizens and members of society? Judged by the benefits they bestow upon the world there can be but one answer. Engineering training is an admirable preparation for leadership in all of the important affairs of everyday life. But why so few *leaders* from the engineering ranks? Is it absorption in the work of the profession, is it diffidence, or is it due to indifference that so few engineers strive for leadership? In times of stress the engineer involuntarily assumes leadership and carries his work forward but, when the crisis is past, he settles back into his professional shell, unheralded and unsung, while others less worthy lay claim to the results of his efforts. The engineer is too modest and retiring. The public at large will not value the engineer and his work properly until he puts a proper valuation upon it himself. He must proclaim his virtues and accomplishments in no uncertain terms.

The only vehicle for such publicity is the written or the spoken word. It must be confessed that the engineer has too frequently neglected to cultivate the power of expression through effective speech and in writing. Although the blame is often placed upon technical education, for the true answer the student of engineering must look within himself. Let him make the most of every opportunity—and there are many—to develop these qualities so essential to leadership. A command of the English language, more than anything else, will remove the handicap of excessive modesty and enable the engineer to reach the highest plane of personal achievement and the greatest possible degree of usefulness to his fellow man.

ATTENTION, CHEMICALS!

The American Institute of Chemical Engineers has recently made known a group of statistics summarizing the requirements of the courses in chemical engineering at 67 colleges throughout the country. The committee in charge has divided the required subjects in the curricula of these colleges into nine general groups of studies and collected data showing the percentage of the total time devoted to each group. Further, the average of all programs has been computed and the variation of each program from the average expressed in tabular and in graphical form.

The committee remarks that "a study of the figures and charts will reveal to each college those points on which it is decidedly out of line with general practice and may suggest modifications that will iron out marked irregularities." Referring to the average program, we note that, while 40.3 per cent of the total time is devoted to chemistry and chemical engineering and 42.1 per cent is occupied by mathematics, sciences, and other engineering subjects (exclusive of electives), but 13.9 per cent is given to cultural studies such as history, literature, and philosophy. If we admit that engineering education is a problem of culture and character as well as one of scholarship, then there is little wisdom in extreme specialization at the sacrifice of liberalizing studies. The significance and importance of this report lies, not in any sudden acquiescence to the average figures quoted, but in the interest in the more general problem of cultural studies that it may provoke among chemical engineers and educators. Most valuable of all is the thought and opinion of the students of chemical engineering themselves.

The outcome of honest thinking about this matter is inevitably a deeper appreciation of the importance of cultural studies and, more practically, a vow to invest more time and attention in these subjects than before. If the economic law be true here, that the desire for a good increases with its scarcity, then the very lack of cultural studies in a technical college must operate to increase their value greatly. How utterly illogical it is to rate a course in history as less important than organic chemistry when the time devoted to history may amount to only one-fifth of the time alloted to chemistry; how blind and narrow to miss the beauty and inspiration of an hour of literature simply because one expects to earn a living through his knowledge of crystals and colloids, of atomic energy, or of the preparation of fatty acids!

Nor is our point of view wholly selfish. The "chemicals" of today are the chemical engineers and educators who shall certainly have a part in the advances that are bound to be made in the field of chemical engineering education during the next half-century. In college, they

(Continued on page 74)

COLLEGE NOTES

Mr. Hendricks was present at the inauguration of Dr. George Daniel Olds as the ninth president of Amherst College at Amherst on November 14. Mr. Hendricks is a graduate of Amherst, class of '17. Dr. Olds has been a member of the faculty of Amherst College since 1891, the year President Coolidge entered Amherst as a freshman.

Professor Paul attended a meeting of the Committee on Building Construction of the National Fire Protection Association at the offices of the National Board of Fire Underwriters in New York on October 21 and 22. The membership of this committee includes engineers and architects of national reputation, insurance men, and representatives of the various forms of building construction, whose purpose is to prepare standard specifications for high grade construction throughout the country.

Professor Paul is also a member of the Committee on Wooden Bridges and Trestles of the American Railway Engineering Association. At a convention in Chicago on November 22, this committee completed standard specifications for wooden bridges and trestles with special references to specifications for materials used and methods of arriving at economical construction.

Dean Monin is the author of an article advocating liberalizing studies in the curriculum of engineering courses, which appeared in the November issue of *Book Notes*, published by the McGraw-Hill Book Company. The plea which he makes for *personality* as well as *performance* should be brought to the attention of, and taken to heart by every young man who contemplates engineering as a profession.

It was our good fortune to have Major General Milton Foreman speak to us at the Armistice day assembly. On this anniversary of a day of universal rejoicing, he sketched the picture of a warless world and held out to us the ideal of permanent world peace. To hear a soldier express his faith in the end of strife between nations is to begin to believe, or to renew an existing belief, in the good sense of mankind.

On December 2, Dr. Lewis Convis presented to us a picture of that little known and little understood country, the Russia of today. His description of picturesque, tragic, ludicrous, human Siberia left us with a broader view of the world than we had ever held before and with a feeling of thankfulness for the happy condition of America.

The name of Armour Institute seems destined to become a familiar one upon the lips of radio announcers. At 6:00 p. m. on Saturday, December 13, a musical program by the Armour Tech Band, under the direction of A. A. Andersen, was broadcast from station WMAQ. A guitar and ukulele specialty was presented by H. H. Chun and E. S. Larson. Were it possible for the waves that transmit speech and music to carry back to the artists the gratitude of the listeners, we know that the men who were "on the air" would feel paid in full measure for the time and energy they have spent in preparation.

FACULTY CLUB

The Faculty Club is the reason for the expression of content and satisfaction that spreads over the face of a faculty member as he approaches the southwest corner of the Mission. The purpose of the club is to furnish a retreat where the professors, after listening to what is *not*, may assemble to shake off the appalling mental lassitude that results from a few hours of contact with embryo engineers. Here in the club rooms they may recover their normal equilibrium by reading *Life*, solving cross-word puzzles, making runs of two and three hundred at billiards, or by counting up the states that went for La Follette.

By common consent of the members, it is understood that the club rooms are for relaxation and recreation only. Consequently, Professors Scherger and Amsbary are the only ones allowed to discuss group separation or the laws of falling bodies. In case of a deadlock, Professor Cooper has been appointed as the court of final appeal. It is commonly understood that all conversation must cease when Professors Schommer and Snow appear simultaneously, in order that they may add one more installment to their serial debate entitled, "Prohibition—Is It or Isn't It?" Fishing remains a favorite subject for discussion, although long experience has demonstrated that the catch-as-catch-can method is the only satisfactory one and that the first liar has no chance.

It is here in the Faculty Club that one discovers the mysterious force that keeps the Armour faculty young, handsome, and human. It is fortunate that there is such a place where rejuvenation is possible, for else our professors were overwhelmed with the daily barrage of questions or submerged by the tragedies of overdue reports and misplaced decimal points.

THE SOPHOMORE INFORMAL

A pleasant break in the round of lectures, recitations, and experiments was provided by the Sophomore Informal, held at the Drake Hotel on the evening of December 12. Confident as the Sophomores were of its success, the size of the crowd and its general air of satisfaction completely justified their fondest hopes. The Drake proved to be a drawing card that brought forth even the most retiring of our bashful engineers. The music, which was furnished by a member of the Sophomore Class, L. O. Castle, established beyond a doubt its claim to the adjective "hot." Twelve o'clock found everybody happy, yet every couple sorry that they could not "Keep on Dancing."

The Sophomore Class wishes to thank the chaperones, Professor and Mrs. C. A. Tibbals, for their kindness. R. C. Peacock, social chairman of the class, and his committee deserve no small amount of credit for the reputation the Sophomores have won as genial hosts and dispensers of delightful entertainment.

Friends of Mr. Amsbary—and we are all his friends—are glad to share with him the invisible audience of radio fans which he entertains via the ether. Those who "listen in" on station WLS have had the pleasure of hearing him at 9:00 p. m. on the Wednesday evenings during December.

THE 1925 CYCLE

This time of year finds the 1925 *Cycle* already well under way. Judging from the progress that has been made, this edition of the Armour year book bids well to justify the high hopes inspired by its predecessors.

The cover will be of a new design and rather unique. It has not yet been decided to whom the book will be dedicated. The new *Cycle* will be distinguished by its art and color work. With the co-operation of our architects and other artists, as well as the Standard Engraving Company, the color work will surpass anything that has been attempted by former classes. The pictures of the Faculty and Seniors will be run in panels along the sides of the pages. The border will be a pleasant surprise to everyone.

The *Cycle* staff is composed of the following members of the Junior Class:

Editor-in-Chief..............D. R. Stiehl
Business Manager..E. H. Marhoeffer, Jr.
Assistant Editor.........D. B. Davidson
Assistant Business Manager.........
.........................W. E. Downes
Advertising Manager.....O. S. Peterson
Humor Editor.............C. W. Barger
Art Editor...............N. D. Barfield
Organizations.............N. C. Sanders
Athletics.................A. J. Danziger
Fraternities..............J. A. Davidson
Photography.............H. C. Mueller

The staff would, at this time, like to solicit the aid of every class and organization in obtaining snapshots, for a year book without snapshots is like a college without activities—something is lacking. With your co-operation in submitting snapshots of your friends—at work and at play—*your Cycle* will be the complete record of a year at Armour that it should be.

Armour men have read with pleasure the short accounts which appeared in the November numbers of the *North Shore Bulletin*, issued by the North Shore Line, and *Rapid Transit News*, issued by the Chicago Rapid Transit System, of the purpose, the work, and the accomplishments of Armour Institute. These write-ups are gratifying, not for the facts they tell us, or for what publicity they may give our college, but because they represent the estimation of Armour Tech in the eyes of a critical world which is always looking for results.

Armour Institute is the birthplace of the first gasoline motor built by the Continental Motors Company. Lee De Forest transmitted his first wireless message from the Institute to the Lakota Hotel. Nor is our Faculty forgotten. The perfection of a sound ranging device, used successfully in the world war, was due to information and formulas given by Professor Wilcox and Professor Palmer. The Department of Architecture possesses an enviable record of prize-winning designs. We are further distinguished as the only engineering college which gives a four-year course in Fire Protection Engineering.

Certainly, it is not unpleasant to read of and reflect on the fame of one's own college. We are proud of the reputation Armour Institute and Armour graduates have established in the past. We are glad that this claim to recognition is granted.

ATHLETICS

THE FRESHMAN RULING

Lately there has been much discussion at the Institute concerning the "Freshman ruling." The present time is suitable for Armour Tech to take sides and to decide whether to adopt it or not. In view of this, we would like to get in touch with the students interested in the question so that any new issues which have not been brought up may be considered. The "Freshman ruling," adopted by the Conference was to the effect that a student could participate only three years in any sport, and could not participate until he had been a resident of the college for a year. It also ruled that no Conference team could play any outside college which did not have a Freshman rule, and that the various freshman teams could not play any outside games.

If we adopt the "Freshman rule" our teams will be able to have "Big Ten" teams as opponents. This will be especially advantageous to the minor sports — wrestling, boxing, tennis and golf — in which great difficulty is experienced in arranging games. Usually only about four or five meets can be scheduled during their respective seasons. Men participating in these sports put in as much time as the men playing major sports and should get a chance to match their ability against outside colleges. In the major sports we are usually outclassed by the Conference teams, but for the past few years our baseball team has been strong enough to make it advantageous for us to meet the "Big Ten" teams. If we adopt the ruling we would require better organized freshman teams which would entail extra expense to obtain uniforms and coaching. Then we could match the freshmen and varsity, and so develop a better varsity. However, in the Conference, it has worked out that the freshmen teams are chopping blocks for the varsity, since the freshmen teams try to develop the style of play of the varsity's next opponent. To some this is objectionable and so Ohio University has introduced a new regime wherein two hundred and fifty freshmen were completely outfitted for football and coached by competent coaches—but were not to play the varsity.

In as much as college after college has adopted the freshman rule since the "Big Ten" approved it, there must be something back of it and we seek the reasons for its development. Its purposes seem to be to deprive colleges of the itinerant athlete who attends the college that gives him the most advantages (not necessarily along educational lines) and to allow the freshmen to get well acquainted with studies and new conditions before being absorbed by athletics. The latter reason is the only one that applies in our case, but does it solve the problem? The freshmen must be allowed to participate in some school activities and especially athletics, for how can we otherwise assimilate them and develop school spirit? The two hundred and fifty freshmen we have cannot be neglected when we consider that they comprise approximately one-third of the student body and, if ruled out, would leave us about five hundred students from which to pick our teams. This is not so serious as it might seem at first glance, for, as a specific instance, only one of the men who reported for the basketball tryouts this season would be made ineligible by the new ruling. This, however, is an unusual condition and should not be given too much weight.

We wish the student body to consider this question and to communicate in some way with the athletic department of The Armour Engineer. Address your comments to the Athletic Editor, care of The Engineer and place them in the mail box in the supply store. Letters received will be considered by the A. T. A. A. when the freshman rule question is decided.

INTER-CLASS BASKETBALL

Inter-class basketball was a success this year, viewed from any angle you choose. In the first place "Stan" Owens, managing the schedule, ran everything so smoothly that the games were played without any postponements. For the first time since "A" men have been barred from participating in inter-class competition, a Senior class team has won the championship. The Senior class and team are proud, and justly too, of their distinction.

The games throughout the tournament were fast, clean, hard fought, and in every way satisfactory. The present Sophomore class, champions last year, could not replace Brockman and the flashy Hellgren (both earned their "A" last year and were ineligible for inter-class basketball). They had a good defense and good team work in offense, but lacked scoring ability. The Freshmen, as is usual, had a good team, but their inexperience and lack of team work proved to be a handicap they could not overcome. The Juniors, although losing all their games, had a better team than their average seems to show. All the breaks were against them and they lost their games by but one or two baskets. Let's wish them good luck and hope that next year, when they are Seniors, they will be able to follow the example of the present "champs" and so allow the championship to rest with the "old men" for another year.

Senior Class Basketball Team.
Rose Burke White Johnson
Chiappe Krivo Weinwurm

The Seniors, represented by a strong and experienced squad, ploughed through their schedule and emerged champions. They were led by George Rose, whose basket shooting was the sensation of the tournament. The defensive work was exceptional and was responsible for the low scores of their opponents. The members of the Senior team who will be awarded numerals are:

S. Krivo, Capt.
G. Rose
L. E. Burke
W. Weinwurm
S. A. Baird
J. White
J. G. Johnson
C. Chiappe

HONOR "A" SOCIETY

For the benefit of the new students we wish to state a few facts concerning the Honor "A" Society. It was formed in 1904 by the "A" men of the school to foster athletics and school spirit at Armour, to preserve the records of our athletes, and to discuss and decide upon the questions pertaining to athletics which affected the students and were to be decided by them. Since the formation of the Armour Tech Athletic Association the "A" Society has worked in co-operation with the A. T. A. A. in conducting inter-class and inter-fraternity athletics and supervising the athletic events and contests of Circus Day. The only students eligible for membership are those who have earned their letter in at least one of the major sports—basketball, baseball and track. The emblem of the society is the small gold block "A" upon which the owner's athletic record is kept. Each letter he earns is designated by a small star upon the gold "A". The position of the star depends upon the sport in which the letter was earned—captain, crossbar; baseball, left leg; basketball, right leg; and track, base.

Members of the "A" Society are:

L. E. Burke
A. Danziger
W. Desmond
W. J. Dixon
W. E. Downes
R. Gaylord
E. R. Geiger
S. Owens
C. J. Plocar
O. Robinson

The officers for the year 1924 were:

President..................W. Desmond
Treasurer..................L. E. Burke
Secretary..................A. Danziger
Athletic Representative.....C. J. Plocar

CROSS COUNTRY

The cross country season this year produced good material. Armour Tech had, under the leadership of Captain

Robinson, a stronger group of distance runners than ever before in its history. On account of causes entirely beyond the control of the management only two races were run. The first was against the strong Northwestern College team at Naperville. Over their four mile course the results were as follows:

1 Reichert
2 Brooks
3 Robinson A. I. T.
4 Craig
5 Hamlet A. I. T.
6 Ulrick
7 Ferguson
8 Grimes
9 Turdle
13 McHenry A. I. T.
15 Kreibeck A. I. T.
16 Herzon A. I. T.
17 Phelan A. I. T.
18 Kratochvil A. I. T.

Time, 23 min. 3 sec.

Robinson's time, 23 min. 28 sec.

First seven men on each team to count.

Score (low score wins), N. W., 37; A. I. T., 68

After this race three schools in succession cancelled their dates for various reasons and consequently there was nothing to be done but try for the Tribune Cross Country race on November 30. This meant grinding out, day after day, regardless of the weather, distances of three, four, and five miles. During this interim Payne, one of the strongest men of the squad, staged two motorcycle accidents in succession and was advised to lay off until spring.

The day of the race arrived with snow, wind, and biting cold. When the starter's gun set the hundred or more athletes in motion, Armour had seven runners in the race. They were: Capt. Robinson, '25; McHenry, '26; Ball, '27; Hamlet, '28; Phelan, '28; Kratochvil, '28, and Herzon, '28.

The race was three and three-quarters miles and at the three mile mark Armour was making a fine bid for its share of the thirty medals, for Hamlet, Robinson, and Ball were running 26, 28, and 30, respectively. Unfortunately, just as Capt. Robinson was starting to coax his men along for the final sprint he was afflicted with runner's cramp, which in its intensity and suddenness is comparable only with swimmers' cramps, and was compelled to relinquish his place. In spite of his condition he urged Hamlet and Ball to plug ahead, with the result that they scored 27 and 28 respectively. Robinson struggled along, walking when he could and resting when necessary. He finished in 48th place, just behind Phelan and McHenry, after displaying as clear a case of sheer grit as one is usually privileged to see.

SWIMMING

Through the courtesy of Athletic Director Stagg, our team has been allowed the use of the U. of C. tank and will be coached by McGillivray. Coach McGillivray has nearly all the men from last year's squad back again and should make our second year of swimming a success. Captain Marhoefer is "knocking 'em off" regularly and is setting the pace and a good example, also, by bringing out a recruit his brother. This seems a brotherly affair when we consider that the Schuler brothers are taking care of their end of it by swimming breast stroke and crawl. Earl DeBourge is threatening to push out the end of the tank with his plunges but hasn't even moved a tile. The other crawl men are "Dick" Osgood and Lamm. "Dick's" specialty is back stroke. "Bob" Brown, fancy diver, is back this year and is as good as ever.

The freshmen have turned out wonderfully for swimming. We certainly appreciate their efforts. They have shown a lot of pep and ought to develop into a good bunch of "tankers."

A. K. Miller, manager, has been trying to arrange for swimming meets with Y. M. C. A. College, Loyola and Lake Forest. These colleges will probably be met in February. At that time we will get a chance to see them in action.

BASKETBALL

We have been exceedingly fortunate this year in our arrangements for the basketball season in that we will play all of our home games at the Armory, 35th Street and Giles Avenue, where there is plenty of room for spectators. In view of this, everyone ought to be out to see some snappy games. The squad has been working hard every day of every week since the first week of December, and the men deserve our support. We've got a good fast bunch with a lot of scrap and they have a tough schedule, so let's get behind them and help them come through with a good record.

Coach Romney had an exceptionally small squad at the beginning of the season—about twenty men. The squad now consists of twelve men. He has been working the squad hard and the fellows have shown so much improvement since the first few practice games that they will put up a stiff game. Romney has developed a fast, short pass offensive game and a five-man defense. Captain McLaren is a whirlwind on offense and defensive. Gaylord, Peterson, Brockman, and Kuffel of last year's squad are playing; Danziger is back after a year's absence from the basketball floor. Huben, Davis, and Geiger, forwards, and Morgan, Weinwurm, and Augustine, guards, are the new men on the squad. How about a little support now, fellows; let's get out there and watch the five horsemen trample over someone!

BASKETBALL SCHEDULE

Dec. 8	Notre Dame at Notre Dame.
Dec. 12	Millikin at Armour.
Jan. 9	Chicago Tech at Armour.
Jan. 21	Augustana at Rock Island.
Jan. 23	Columbia at Dubuque.
Jan. 24	Dubuque U. at Dubuque.
Jan. 30	Augustana at Armour.
Jan. 31	State Normal at DeKalb.
Feb. 3	Millikin at Decatur.
Feb. 6	Dubuque at Armour.
Feb. 12	Detroit College of Law at Detroit.
Feb. 13	University of Detroit at Detroit.
Feb. 14	Western State Normal at Kalamazoo.
Feb. 20	Marquette at Armour.
Feb. 25	Marquette at Milwaukee.
Feb. 27	N. I. S. Normal at Armour.
Mar. 4	Chicago Tech at Chicago Tech.

This schedule is tentative and is subject to changes.

New Cable to Link America and Germany

The Commercial Cable Company announces arrangements with the German Atlantic Telegraph Company for the laying of a cable between Germany and the United States. The cable from New York to the Azores will belong to the former company, and that between the Azores and Germany will belong to the latter company. The cables which will be of the latest, high speed design, will be automatically connected at the Azores.

Electrical World.

WRESTLING

ARMOUR AT NORTHWESTERN

NORTHWESTERN		ARMOUR		WINNER	TIME
White	125	Swanson	120	Decision, N. W.	8 min.
Baldwin	157	Green	158	Draw	
Howard	151	Eisenberg	148	Fall, N. W.	6 min.
Rubio	119	Schwarz	113	Fall, N. W.	4 min.
McPhereson	141	Janack	126	Decision, N. W.	8 min.
Anderson	141	Kohn	137	Fall, N. W.	3 min.
Kuehn	141	Lickton	146	Fall, N. W.	4:30 m
Lowry	170	Geymer	188	Decision, A.	5 min.
Lewis	167	Weisberg	185	Fall, N. W.	5 min.

NORTHWESTERN AT ARMOUR

Rubio	119	McHenry	120	Decision, A.	8 min.
Stutz	122	Swanson	122	Decision, A.	8 min.
Keagle	135	Janack	138	Fall, A.	1:10 m
Lewis	168	Green	156	Fall, N. W.	4:40 m
Kuehn	140	Price	137	Decision, A.	8 min.
Howard	151	Eisenberg	146	Draw	8 min.
Hathaway	158	Geymer	188	Draw	8 min.
Lowry	170	Weisberg	185	Fall, N. W.	5 min.
Day	146	Lickton	146	Fall, N. W.	5:40 m

These two meets were held in December and were successful in that they showed up our weak points. When one considers the two sets of results, it is obvious that the squad took advantage of the first meet to find their faults. In the first meet the only Armour man to score was Geymer, who won a decision over Lowry. Green held his man to a draw but the other men lost by either decisions or falls. With this match to base training upon, Coach Smith drilled his men to such advantage that Northwestern College had tough going when they visited us.

In the second meet with Northwestern, Janack earned his letter by throwing Keagle during the second minute. While it lasted, the bout was bewilderingly fast until Keagle was pinned by a body scissors. Due to his aggressiveness, Price obtained a decision over Kuehn. McHenry and Swanson outpointed their men, but could not pin them in the allotted eight minutes. Weisberg had the hard luck to be pinned just as the time was up. He was outclassed, but put up as fine a showing of grit as has ever been seen on the home mat. Lowry clamped a terrific scissors on him, but Weisberg held out and finally broke the hold only to be pinned by another scissors.

Manager A. S. Laederach has been having difficulty arranging meets because none of the Big Ten can meet us. The next dual meet will be with "Y" College and some good matches are certain, because of the strong "Y" aggregation. The only other meet contemplated at present is with Notre Dame who will meet us on their floor.

ENGINEERING NEWS

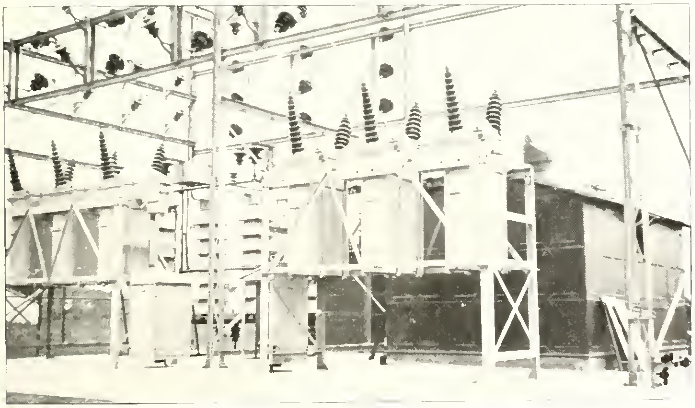
Electric Power Station Controlled by Radio Waves

The "Open Sesame" which Ali Baba used to open the den of the forty thieves is rivalled by the use of high frequency radio waves to control and operate from a distant point, entirely without attendants, a complete electrical station. This station is located at Tipton, Indiana, near Indianapolis, and supplies the light and power requirements of 10,000 people.

Through the special design of a system of selector relays to operate with the automatic, duplex carrier current telephone receiver already installed at the station, the feat which makes new electrical and radio history was accomplished.

John Ferguson, manager of operation of the Northern Indiana Power Company, co-operated with engineers of the Westinghouse Electric and Manufacturing Company in designing the apparatus; and it was installed under the supervision of Mr. Ferguson and C. A. Boddie, inventor of the automatic, duplex carrier current receiver and transmitter.

The city of Tipton is served by transmission lines connected to a large transforming substation located at the western city limits. In order to insure that the electrical supply will be without interruption, two lines from different sources of power, the Kokomo and the Noblesville power plants, are used. If either of these transmission lines should become interrupted by reason of electrical storms, the supply can be resumed immediately from the alternative source. Formerly the operation of the oil switches to change over the source of supply necessitated the constant presence of substation attendants, who received their instructions for operating the switches by long distance telephone.

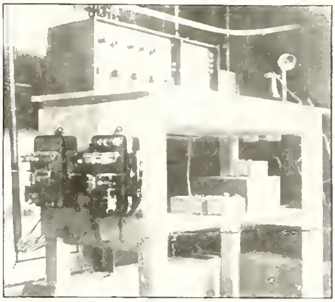

Oil circuit breakers actuated by the selector relays which receive their impulse from a five tube radio set.

Telephone systems, however, are even more vulnerable than power lines to the action of the elements, and power companies in the past have been unable sometimes to render continuous service during storms. The engineers of the Northern Indiana Company felt that present-day requirements of supply demanded standards of continuity higher than have been possible heretofore. The present substation at Tipton, the operation of which is governed entirely by high frequency waves, is the result of their efforts, and marks a new era in electrical development.

The station is controlled by two massive oil circuit breakers of 73,000-volt, 400-ampere rating, with a rupturing capacity of one and one-half kilovolt amperes. These circuit breakers are connected to the transmission lines, one from the north, and the other from the south. If one of these lines develops any trouble, it is instantly observed on the power house instrument at Kokomo. In this event, the Kokomo operator immediately sends out a series of high frequency waves which opens up the oil switch at Tipton connected to the defective line, and closes the oil switch which is connected to the reserve line. The entire operation is completed within a few seconds.

The method by which this is accomplished is as follows: The operator at Kokomo dials a certain number on a telephone of special design similar to an automatic telephone. This telephone dial is connected to a radio transmitter, and the action of dialing sends out a series of modulated radio impulses to the antenna at Kokomo. Upon receiving these impulses, the antenna at the Tipton station leads them down to a five-tube radio receiving set and amplifier, where they are multiplied in volume while still retaining their form characteristics. They are then carried to a series of selector relays, which in turn operate the storage battery switches which actuate the oil circuit breaker mechanism. A special wave length entirely outside the broadcasting range is used. The series of impulses is as complex as the combination lock of a safe, and is in no way subject to extraneous influence. Tests have demonstrated that the apparatus works with infallible accuracy.

Notwithstanding the massive nature of the machinery which is controlled by this infinitesimal force, the tests have shown that, instead of dialing a number with the finger, the oil circuit breakers could be operated with the human voice, so sensitive is the radio controlling apparatus. It would actually be possible to adjust the apparatus so that the operator at Kokomo need only say the words, "Open, circuit breakers," and the breakers, twenty-five miles away, would open.


The radio set operates the selector relays attached to the side of the table.

Motor Truck at Armour Institute for Test

The new Saurer truck, of European manufacture (Arbon, Switzerland), underwent a recent demonstration at the Armour Institute of Technology automotive laboratory, which revealed several new and favorable points. A description of the truck in a past issue of "Automotive Industries" brings out many unique features of construction.

The four cylinder, monobloc motor develops forty horsepower at 1000 r.p.m., and is regulated at this speed by a governor acting on the carburetor float chamber. The transmission comprises four forward speeds and one reverse speed. The fourth speed forward is direct drive, which probably partly accounts for the extremely low fuel consumption of the truck. The machine contains many of the refinements which makers of high grade European cars are in the habit of using. The lubrication system embodies a constant replenishment of fresh oil at a slow rate, a principle which is much in vogue among continental manufacturers.

The ignition system is arranged so that there is no possibility of back firing when starting. The operation of the starting crank by the driver engages a cam on the timer which sets it for late ignition, no matter what the setting of the spark control on the steering column may be. A new idea in axle design is the arched rear axle provided on the truck. The rear wheels are slightly convergent when the machine is unloaded, and as the axle straightens under the action of the load, the wheels will become parallel. This has the effect of eliminating uneven wear of the rear tires on crowned roads. The car carries dual driving tires, and much of the effect of the double tread is lost if they wear down unevenly. In the matter of rear axle design, the Saurer truck probably stands almost alone in its use of the bevel gear drive. By far the majority of the manufacturers prefer the worm drive for trucks of the same capacity (six and one-half tons).

The machine is also distinctive in the use of a motor brake, whereby the energy of the car on braking is absorbed in turning over the engine. This, of course, may be done on any car, but the retarding effort of the motor when being driven in this fashion is due to the action of the valves. These allow the energy expended in compressing the air during one part of the stroke to be returned when the air expands during the latter part of the stroke. The Saurer design eliminates this disadvantage by providing for a shift of position of the camshaft when the motor is to be used as a brake. The operation of the motor brake pedal moves the camshaft so that the valve timing is changed to allow correct pumping action of the motor. In this manner the maximum retarding effort of the engine is utilized.

Dr. Faccioli Talks on High Voltage Phenomena

At a recent meeting of the Chicago chapters of the American Institute of Electrical Engineers and the Western Society of Engineers, Dr. Giuseppe Faccioli gave a highly instructive, illustrated talk on high voltage phenomena. Dr. Faccioli was for many years an associate of the late Dr. Steinmetz in high voltage work, and is now carrying on research in the field of high voltage.

Faccioli was born in Italy, and received his technical training at the Institute of Technology at Milan. Coming to America at the age of twenty-two, he found employment with the New York Edison Company, and later with the Crocker-Wheeler Company. Here he met and became associated with Mr. Stanley, a pioneer in electrical engineering, and inventor of the alternating current transformer. Faccioli became a part of the Stanley organization, and went with him into the service of the General Electric Company in 1908.

The work by which Mr. Faccioli has won so high a place in electrical engineering has been concerned very largely with matters relating to high tension transmission, the development of transformers, lightning arresters, and similar equipment. He directs the work of the General Electric high voltage engineers who have made spectacular demonstrations of transmission up to two million volts, and of the imitation of lightning at similar voltages.

Carbon Dioxide Gas is Used in Place of Ice

The success that has attended the experiments recently carried out in the shipment of fish from Halifax, Nova Scotia, to Montreal, in which carbon dioxide was used for refrigeration instead of ice, has induced a company manufacturing this gas to establish a plant in Halifax.

Chemical and Metallurgical Engineer.

A Recent Development in Electric Traction

A new type of electric locomotive to be built for the New York, New Haven, and Hartford Railroad is significant in that it suggests a means whereby the long-standing controversy between the advocates of alternating current traction and those of direct current traction might be ended. The new development may prove a solution which combines the advantages, and eliminates the disadvantages of both systems.

The new locomotives, seven in number, will each contain a traveling substation, and will be equipped with a synchronous motor-generator set for converting the 11,000 volt, 25 cycle, single phase trolley supply to direct current. Direct current railway motors will drive the axles.

Power is collected by the usual pantograph trolley, and is delivered to a main transformer situated in the locomotive cab. Here the trolley potential is stepped down to 2300 volts for driving a single phase synchronous motor, which is direct connected to the main direct current generator. This machine supplies current to the traction motors, and is equipped with a variable field for the purpose of controlling the speed of the locomotive. The traction motors are of the standard series, direct current, railway type, the performance of which is well known. They are connected to the axles through cushion type gears, which allow a small movement of the gear ring about the hub, thus minimizing shocks and stresses in the gears and pinions. Between the trolley and main transformer is installed a time limit, automatic, oil circuit breaker. Between the generator and traction motors are the high speed circuit breaker and line switches. The high speed breaker will afford protection to both motors and generators, and will ordinarily prevent the opening of the time limit switch, or trolley and feeder sectionalizing switches, preserving continuous operation of the converter set.

The generator field system of speed control, in connection with the characteristics of the motor-generator set, gives a locomotive which is extremely flexible and adaptable to all operating conditions. It also has the desirable characteristic of permitting operation at a high power factor through a wide range of loads. The synchronous motor may also be used to correct the power factor of the line while running at light loads. This tends to improve the trolley voltage for all load conditions. The locomotives are designed to operate in multiple with the present single phase locomotives on the New Haven road.

The idea of the motor-generator locomotive is not a new one, and it possesses many attractive possibilities. Before the advent of the high voltage direct current motor, the weight of the necessary apparatus was found to be prohibitive, and for this reason development along the present lines was impracticable. Economy requires that transmission and distribution of power for railway lines be by means of alternating currents, but the direct current traction motor is unquestionably cheaper to build than any other type. The combination of the two features offers to the railroads an interchangeable unit that may be transferred from one electrically equipped road to another, with a resultant flexibility of operation equal to that attained by steam equipment.

Journal of the A. I. E. E.

Highest Head Reaction Turbine Placed in Operation

A reaction turbine designed for the highest head ever used up to date went into operation when, on August 4, 1924, the first unit of the Oak Grove hydroelectric development of the Portland Electric Power Company was placed in service. The unit is a Pelton, 35000 h.p., 514 r.p.m. vertical turbine operating under an effective head of 860 feet, and driving a 30,000 Kva., 11000 volt, 60 cycle General Electric alternator with direct connected exciter.

Water for the plant is diverted from a river 6.6 miles distant by means of a nine foot steel pipe line to a surge chamber above the power house. The penstock is 1,360 feet long, eight feet in diameter at the top and six feet in diameter at the bottom. At the top of the penstock is a 96 inch Johnson valve which can be operated from the power house, and which will close automatically within 30 seconds in case of a break in the penstock. At the bottom is a 72 inch butterfly valve which is a part of the wheel casing.

Power.

Aluminium Alloy Motorbus Wheels

Aluminium alloy wheels for motorbuses have been experimented with by the London General Omnibus Company in England. These wheels have only half the weight of a standard wheel, and many of them have now been running over 30,000 miles in regular service. The advantages claimed for these wheels are that there is a reduction in the unsprung weight of the vehicle, that the destructive action on the roads is reduced, and that the scrap value of the wheels is high—about two-thirds of the original value.

Machinery.

Bridge Construction in France

France leads in the construction of reinforced concrete bridges of great span. Recently such a bridge was completed in France in which the span of the arch was approximately 600 feet. Another bridge is now being planned that will have three spans, the lengths of which will be approximately 680, 645, and 620 feet. This structure will be erected during the next three years at Brest. The height of the arches will permit a free opening for navigation, 230 feet wide and 100 feet high.

Machinery.

To Explore Arctic by Airplane

Captain Roald Amundsen, the Norwegian explorer who was the first to reach the South Pole, disclosed in a recent interview his plans for an airplane flight from Spitzbergen to the North Pole, and thence to Alaska. The object is the possible discovery of a continent or a great archipelago supposed to lie in the million square miles of the Arctic which remain unexplored.

"We shall start from a bay in North Spitzbergen, next June," said Amundsen. "We shall have twelve men and either two or three planes of the Dornier 'whale' type, which are of Italian make, each with a cargo capacity of five thousand pounds. The flying time from Spitzbergen to Alaska should be twenty-one hours. Several hours will be spent in observations at the Pole."

Aviation.

THE SLIPSTICK

"Some Special Methods in Analytical Chemistry"

By A. Freshman

It has been my custom during the course in analytical chemistry to observe certain special methods employed by various members of the class that were not outlined in the text book. These methods have been employed indiscriminately and without due regard to their relative values and reliability. I therefore propose to give a list of the best of these methods with notes appended in regard to their individual characteristics, application, and value. It might be added that these methods are only to be employed by men of a lazy or indolent natnre or those who are pressed for time.

The classification is as follows:

Method I (Flipping Coin).

This method is to be employed in case of doubt in the choice of one of two unknowns to be reported present. It is an even break between instructor and student and should be used only when the student hasn't been inspired by divine aid.

Method II (Hunch Method).

You, who are fortunate enough to have hunches, may rely on this method in all instances above all other methods given here. As an added precaution it is advised that you possess certitude as to the existence of the hunch.

Method III (Selection and Comparison).

The procedure consists in comparing your work with that of other members of the class. Ask the man whose sample is most like yours what he has found. If there are one or more samples like yours ask the man with the highest quiz average. Method III is better than Method I, but is not as good as Method II.

Method IV (Information from Instructor).

Engage the instructor in conversation. Insiduously and subtly inject in the conversation the questions you want answered that he is not supposed to answer. If possible edge him over to your desk and get him to work your experiment while under the spell of your conversation. On no account attempt to bribe him with cigars. Instructors do not smoke.

This method is very reliable, but it is almost impossible to work unless the student has exceptional personality and diplomatic instinct.

Method V (Slipstick Method).

When two samples have been analyzed and the results do not check, the slipstick should be used. First determine which of the two samples is the more accurate analysis by Methods I, II, III, and IV. Next calculate the other sample with the slipstick. As its name indicates the slipstick can be made to slip at will to give any desired answer.

This ends the list of the most important and reliable methods. All other methods are modifications or cheap imitations.

Fond mother to friend—"I am so proud of my son. Why would you believe it, he is so popular that he got more valentines than any boy in his class."

It is understood that some of our professors are preparing books for publication. We have the inside dope on the titles, which are as follows:

"Details of Slide Rule Destruction," by Prof. D. F. Campbell.
"Things of That Kind," by Prof. A. H. Carpenter.
"The Care of Twins," by Prof. S. E. Winston.
"My Adventures in China," by Prof. O. C. Clifford.

"The Slipstick"

The slipstick rests in its leather case
With ne'er a foreboding thought
Of the agonized, soul-trying, wood-scratching pace
That soon on its slide will be wrought.

It's always ready to enter the fight
Tho' the glass is cracked and bent.
If the figures don't come the way that's right,
The slipstick will lie like a gent.

So here's to the slipstick, sing ho my lads!
Raise your glasses high and drink deep.
For the slipstick, the jolly old slipstick, my lads,
Is the friend that your secrets can keep.

Description of a class dance as Edgar Guest would write it:

The work that makes the world go 'round
Must be tempered with laughter and play.
So I laughed out loud at the joyful sound
Of lads and lassies at play.

They danced to the tunes of melodies gay
And their faces were shining and bright,
And dark eyes smiled at eyes of gray
And the gray held an answering light.

I thought as I traveled my homeward path
The world's not a bad old place.
For when young folks can dance, make merry, and laugh,
Of sorrow one finds not a trace.

As Carl Sandburg would have written it:

There are many bright spots of color that whirl.
They are shifting and ever changing.
Wierd, diabolical laughter rends the air.
The saxophones are wailing and urging.
The tom-tom beat sways one strangely to long forgotten rhythms.
One can almost see firelight and dim savage figures.

Beethoven, you wasted your time on the minuet,
For the youths who will guide the wheels of industry
Have forgotten things such as you have done.

A New Style for Textbooks

Mr. Merriman in his treatise on hydraulics, describing a stream of water issuing from an orifice writes: "The appearance of such a stream issuing from a circular orifice is that of a clear crystal bar whose beauty claims the admiration of every observer." Now I ask you isn't that touching? Doesn't it warm the cockles of your heart to find romance like that in a technical book? After reading a description like that, one doesn't mind a little thing such as a coefficient of contraction or discharge.

Why can't all our books be written that way? If you saw a book entitled, "Treatise on Atomic Structures," you would run a mile to avoid it, but suppose the author called it "The Home Life of the Atoms, or Electrons at Work and Play," in a short time it would be a best seller.

Think what bliss it would be to study calculus if this plan were adopted. How interesting to read an explanation like this: "To our right and as far as the eye can reach, stretches a long line of first derivatives. Before us the graceful, sinuous curve of an integral sign spreads itself in scroll like ecstasy, claiming the admiration of every beholder. To our left, transcendental functions gambol and play with childlike glee."

Or we might read something like this: "Grasp the switch firmly with the right hand, whistling all the while to keep up your courage. With a delicate flip of the wrist throw the switch, thus dropping the voltmeter gently from the bus. After a little practice this may be done in such a manner as to produce a display of electric fireworks whose beauty claims the eye of every observer."

With the earnest support of all concerned we may be able to bring about such a change by the time Chicago gets a subway.

If you want to find out whether a man came from Armour or not, there is a very easy method. You walk quietly up to him and say the word "When." If he snaps out "Always" as a reply you may be safe in saying, "Put it here, brother, I am from Armour, too."

Statistics gathered for the observation of the application of men to their studies show these results:

Men who resolved to study during Christmas holidays	100%
Men who studied during Christmas holidays	0%

As a revival of that once popular ditty, how is this verse for "It ain't gonna rain no mo'?"

My boys, I know they work you hard
So my assignment will be light.
Take chapters one, two, three, and four,
and study half the night.
It ain't gonna rain no mo', no mo', etc., etc.

Naughty! Naughty!

We'd like to know who the wag was that gave Dean Monin shaving cream for a birthday present.

SOCIETIES

A. I. E. E. SMOKER

Well, men, we have just had the A. I. E. E. smoker and we want to tell our friends who were not able to be present about the most unique affair ever staged at the Armour Institute of Technology. At the mere mention of the word "smoker" most people picture pieces of hemp called cigars, some speeches, and two or three hours lost sleep. The Senior members of the A. I. E. E., being live wires and possessing unusual talent, decided to put on a new kind of entertainment that would serve as an example of how a real, honest-to-goodness smoker should be conducted. George Taylor and Bill Sothen were given the job of arranging the program and you will see from what follows that a better selection could not have been made.

After about seventy men had assembled, the program was started by Earl Tweedle who played two classical selections on the violin, with Bill Desmond as accompanist. It is remarkable that a man of such wonderful engineering ability should be such a great violinist.

The second number on the program proved the surprise of the evening. It is hard to take Stan Owens seriously, but while he is giving one of his readings he can sway any audience from laughter to tears at his will. More than one man clutched the arms of his chair while Stan was giving "The Shooting of Dan McGrew." The fellows were so agreeably surprised that they wouldn't let Red go, so he obliged with some readings from his favorite poet, Rudyard Kipling. The selections were "The Hanging of Danny Deever" and "Gunga Din."

Herbert Chun with his steel guitar and Stan Larson with his ukulele, both of radio fame, played four or five numbers together. Larson also sang several solos. The boys were so well appreciated that the applause almost stopped the show. Bill Desmond then took the spotlight and gave us ten minutes of popular music.

In concluding the program Ed Meyer called his henchmen together and the boys gave the most remarkable college yell ever heard anywhere. It took three years of patient effort for the Senior Electricals to develop this masterpiece.

We then started the cards going and played everything from poker to bridge, but after a short time the boys became uneasy. The rattle of dishes was plainly audible and everyone was anxious to get at the eats. The quantity of food which everyone was able to dispose of, left the assembly in a state of somnolent satisfaction.

Don't forget that the regular meeting dates are the first and third Thursdays of each month. Come out and you will appreciate the benefits a membership will bring to you.

AMERICAN INSTITUTE OF CHEMICAL ENGINEERS

The society has been very fortunate this year in obtaining speakers of national reputation who have presented forcibly the problems, responsibilities, and processes of manufacture, of interest to the chemical engineer.

On November 20, Mr. Otto Eisenschiml, the owner and manager of the Scientific Oil Compounding Co., talked on the subject, "Chemistry as a Business Career." Mr. Eisenschiml brought home to us some of the difficulties to be overcome in order to be successful, and gave us a rule that he himself had followed, namely, "Keep out of routine work."

On December 4, Mr. Carl S. Miner, of the Miner Laboratories, presented the subject, "Furfural, the Story of an Industrial Problem." His presentation was accompanied by an exhibit of raw materials, and products. It was an example of how to meet and solve an engineering problem, and emphasized the value of quantitative work.

The big event of recent note was the Smoker given at the Phi Pi Phi house on the evening of December 17. President Deutch picked a program committee of note, and turned out a C. P. product.

WESTERN SOCIETY OF ENGINEERS

On Thursday, October 16, the Armour Branch of the Western Society was most agreeably addressed by Mr. Jacob L. Crane, noted city planner, who gave us an insight into city planning and its intricacies. Mr. Crane knew his "stuff" as the saying goes, and the fact that his lecture was illustrated made it of twofold interest and importance.

On Thursday, November 6, Mr. E. T. Howson, of the Simmons Boardman Publishing Co., addressed our branch. Mr. Howson is the National President of our society and we cannot help but feel highly honored by his visit. The subject of his talk was "How the Young Engineer May Sell and Create a Demand for His Services." The value of information and experiences given by Mr. Howson cannot be estimated and it is our sincere regret that more men from other departments were not present to hear his talk.

On November 20, Dr. Mohlman, Chief Chemist of the Sanitary District of Chicago, explained the details of the sewage disposal system of Chicago. He took us all the way from Winnetka to Lockport in less than an hour of illustrated lecturing. Dr. Mohlman will be remembered by his article in the last issue of The Armour Engineer.

December 4, Robert H. Ford of the Chicago, Rock Island & Pacific lines spoke on "Success in Engineering." Mr. Ford laid stress on the fact that we are all entirely alike in brain capacity, success being largely a matter of sticking to a thing.

ARMOUR TECH MUSICAL CLUBS

The musical clubs have lived up to the assertions made for them in the November issue of The Armour Engineer.

On December 4 the Orchestra and Glee Club appeared at the famous Hull House of Miss Jane Addams and put on an evening's program before an appreciative and enthusiastic audience. At the close of the concert, refreshments were served and then an impromptu orchestra made dancing the main feature until nearly midnight.

On Sunday, December 7, the clubs gave a public rehearsal at the Home for Destitute Crippled Children, 1653 Park Avenue. By means of these appearances the club members acquire stage presence for the later formal concerts and also identify Armour Tech with those who are contributing to the civic improvement of the city. It is the policy of the management each year to give some eight or ten of these free concerts early in the year to deserving institutions.

On December 13, the Band played to its greatest audience via the radio from the Daily News broadcasting station. For forty-five minutes the ether was burdened with ensemble, trombone and cornet duets, saxophone sextets and various types of wind and string produced music. Mr. A. A. Andersen has labored faithfully with the material available and deserves much credit for producing an impression sufficiently favorable to insure the appearance of the Glee Club on the ether at a convenient date.

The Band, Orchestra and Glee Club gave a concert at the Halsted Institutional Church on December 15. The proceeds from the concert are to be applied to the construction of a new church upon the site of the old one, which is to be torn down in the near future. Every member of the musical clubs will be justified in feeling that he has had a part in the building of the new church, which is to be a magnificent edifice. It is a pleasure to be able to help so worthy a cause.

Every student should fully appreciate what a vast benefit the musical clubs are to the college, and should lend them every support. Students who play some instrument should not hesitate in going to the clubs and offering their support. The Orchestra needs more members, especially violin players who should enter at once to help in the preparations for the Home Concert.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS

The student branch of the American Society of Mechanical Engineers held its first meeting, October 16. President Regensburger opened the meeting by introducing to the society Professor Gebhardt, head of the Department of Mechanical Engineering. Professor Gebhardt has a personal interest in the society, and its success here at Armour is the result of his earnest co-operation in all our endeavors.

Unlike the other engineering societies in the college, which have outsiders talk to them from time to time, we have devoted our time and interest to enabling our own members to become accustomed to talking before an audience. The results and benefits are self-evident, judging from the interesting talks which have been given by our members.

Among the speakers were Mr. Kramer, who talked on the "Merits of Welded and Riveted Joints," Mr. Stahl who spoke on "Automobile Shackles," and Mr. Ostrin who told us about "Die Casting." Mr. Eugene Odenwaldt gave an illustrated talk on "High Temperature Insulation." Various facts concerning insulation and heat losses were brought out, together with the effects and uses of insulation for different purposes.

Our interest at the present time centers around our annual smoker which is to be held soon. We hope to make it the best we have ever had, with plenty of good smokes and good things to eat.

FRATERNITIES

ETA KAPPA NU NOTES

Members of Eta Kappa Nu had the opportunity of making an inspection trip to the power plants of the Sanitary District of Chicago at Lockport and plant No. 9 of the Public Service Company of Northern Illinois on the *evening* of October 22. As a culmination of the trip the Invitation Banquet was held and the following men were pledged to Eta Kappa Nu:

A. A. Anderson '25
C. A. Bishop '25
G. J. Taylor '25
C. E. Tweedle '25
H. C. Hoff '26
E. F. Johnson '26
H. J. Prebensen '26

November 18 found the entire chapter assembled at the Engineers' Club, to participate in a joint banquet with the Chicago Alumni Chapter. Every chair was filled, the dinner, one to boast about, the cigars real Havanas—in short, everything was all set for a real get-together. After dinner, chairs were pushed back and the real business of the evening begun. Brother H. T. Dosch, who is in the advertising game, sold us on "Direct Advertising," by his short snappy story of the Western Electric salesman. With this as a starter things opened with a bang. Our pledges enlightened us on various subjects with which they were familiar. An involved discussion followed each, and it was nearly eleven o'clock before we called it a night and caught the train home. The Chicago Alumni Chapter is one of the livest of its kind in the country, and we, who are still undergraduates, highly value the opportunity it gives us to associate with those who are actively engaged in the profession.

On the day after Thanksgiving, Chun, Meyer, Sothen, Taylor, and Tweedle motored down to the Aetna plant of the Northern Indiana Gas and Electric Co. This plant has a large outdoor substation from which the current is sent out at 133,000 volts. They brought back with them an interesting set of pictures of the plant showing very clearly the unique features of the installation.

The pledges were initiated into membership December 18, and that's all until next time.

SCARAB OFFERS COMPETITIONS

The annual Scarab convention was held at the University of Illinois on November 28 and 29. Mr. Earl Bush served Edfou Temple as delegate.

This year Scarab is promoting two competitions with prize awards for the winners. One prize will be offered through the Beaux-Arts Institute of Design in New York. This prize may be won by any student of architecture. The other prize competition will be restricted to the members of Scarab in the various institutions throughout the country.

Edfou Temple is particularly concerned at this time with the gathering of sketches for the traveling exhibition of water color, pencil, and pen-and-ink work. This collection, as its name implies, is sent from chapter to chapter to enable the students and faculty to become better acquainted with the work done in other schools.

PI TAU SIGMA

Announcement is made of the installation of Delta chapter of Pi Tau Sigma at the Armour Institute of Technology on December 22. Pi Tau Sigma is a national honorary mechanical engineering fraternity, founded at the University of Illinois, March 16, 1915. The purpose of the organization is to foster the high ideals of the engineering profession, to stimulate interest in co-ordinate departmental activities in the universities, and to promote the general welfare of its members.

The emblem of the fraternity is a watch key having the form of the Carnot cycle. In the upper part of the cycle is supported a flaming torch, in the center are the Greek letters Pi Tau Sigma, and in the lower part is a steel H-section. The fraternity colors are murrey and azure; the flower is the white rose.

Those men pursuing the course in Mechanical Engineering and whose scholarship ranks within the upper one-third of the class at the beginning of the third year are eligible to membership. The selection of members is based upon engineering ability, leadership, and personality.

There are now five chapters of Pi Tau Sigma, the following institutions being represented:

University of Illinois
University of Wisconsin
University of Minnesota
Purdue University
Armour Institute of Technology

The organization of a chapter of Pi Tau Sigma at Armour Tech was undertaken in the spring of 1924 by a number of Juniors who felt the need of a unifying force among the students of Mechanical Engineering. In drawing up a petition for a charter, Dean Monin's kindly interest, as displayed by his support and advice, was invaluable. The petition won the whole-hearted approval of Dr. Raymond and Professor Gebbardt. It was presented, together with the standing of the nine men signing it, at the National Convention of Pi Tau Sigma, held in Minneapolis on October 15. The petition was unanimously accepted by both the Executive Council and the individual chapters, and a charter was granted.

The installation of Delta chapter took place at the Theta Xi fraternity house, under the direction of Alpha chapter of the University of Illinois. Mr. Earl V. Johnson, president of Alpha chapter, presided over the ceremonies. The following men were installed as charter members:

HONORARY MEMBERS

Professor G. F. Gebhardt
Professor Daniel Roesch
Professor P. C. Huntly

SENIORS

S. A. Baird
E. G. Benson
J. P. Dunlap
W. C. Kramer
G. S. Maffit
E. W. Odenwaldt
H. W. Regensburger
C. M. Rowley
J. M. Shoemaker

Following the initiation, a banquet at the Lakota Hotel was given in honor of Alpha chapter by the newly instituted Delta chapter. Professor Gebhardt was master of ceremonies. The speakers of the evening were Mr. Earl V. Johnson, Mr. George Maffit, and Professor O. C. Leutwiler.

In conclusion it may be stated that the charter members have pledged themselves to take an active interest in Delta chapter for two years and to make this organization a credit to Armour Institute.

PHI LAMBDA UPSILON

Phi Lambda Upsilon, honorary chemical society, was founded at the University of Illinois, in 1899. At present there are twenty active chapters in the organization. The chapter at Armour was chartered in 1920 and is designated by the Greek letter, Omicron.

The election of members takes place bi-annually. The basis of election is scholarship, which is determined by averaging chemical grades with all others and giving the former twice the weight of the latter. Two votes are taken on each candidate, the first on scholarship and the second on personality. Personality is considered only in as far as it pertains to good habits, neatness and honesty. Campus activities do not give any added weight to a candidate's eligibility.

It is surprising to note that with these standards, each of the nine men in the society is engaged in one or more of the various college activities. We boast of two class presidents, three honor marshalls, four men on the staff of either of the college publications, four officers of the A. I. Ch. E., two leaders in the organization of two of the non-technical clubs, and a member of the Tech basketball team.

On December 20, four men received the treasured key. They are as follows:

L. E. Kraus '25
W. H. Weinwurm '25
J. S. Perry '26
B. H. Schenk '26

On the same date the old and new members and a host of alumni gathered at the University Club for the banquet.

SPHINX

Sphinx wishes to announce the pledging of the following men:

G. D. Arachovitis
E. R. Hubbell
E. H. Marhoefer, Jr.
E. M. Meyer
C. M. Nelson
W. H. Sothen
D. R. Stiehl

These men have distinguished themselves by their work on the college publications and the present members of Sphinx believe they are worthy of wearing the black and gold ribbon.

The present officers of Sphinx, elected at the close of last semester are:

President..............H. P. Whitehill
Secretary-Treasurer.H. W. Regensburger

SALAMANDER

The present active chapter has all the enthusiasm necessary for a good organization. It does lack the dignity of numbers, however, which must be accounted for in other ways.

Due to the small number which now constitutes the active chapter, alumni members who reside in the city were invited to assist at the fall election, to lend stability to that function. The result was the pledging of the following seniors:

W. H. Baldwin
D. C. Mulligan

We have received letters from many of the alumni, which will constitute a part of the "Deflector," the chapter paper. All of the alumni seem to be nicely situated, but express regret that they are not back at the old grind.

CHI EPSILON

Chi Epsilon is a national honorary engineering fraternity. Its object is to fittingly honor the civil engineering students, who, through their achievements at school, deserve recognition. The requisites for membership are scholarship, character, practicability, and sociability, the four requirements of the successful engineer.

The men who were elected to membership this fall are:

G. D. Arachovitis
W. J. Dixon
J. P. Frisch

After having successfully completed a rigid pledgeship, these men were initiated into the Armour Chapter of Chi Epsilon on December 4. The initiation banquet was held at the Pershing Hotel and was well attended by our alumni members. Talks on various subjects were given by our honorary members, Mr. E. G. Nethercut, and Professors A. E. Phillips, J. C. Penn, and M. B. Wells.

Our activities for the balance of the semester will consist of literary meetings and the election of officers for the last half of the year.

S. K. D. HAS HOUSEWARMING

The month of November was one eventful month for Sigma Kappa Delta. It started out nicely on the first day with a Hallowe'en dance. Every one had a real peppy time and the girls were pleased beyond mention with the programs, which were gray leather pocket books. Then on the following morning we lost our back yard fence, due to a small fire which had started from some of the discarded decorations placed out there. The next few weeks were uneventful. The fellows studied hard and went out over the week ends to gain a broader education. Then on November 25 things started again. About six o'clock in the morning, Stan Newlin woke up with his lungs full of smoke. Thinking the furnace was doing all the dirty work he proceeded down stairs. This was very difficult to do in the heavy smudge. On reaching the first floor he saw the flames leaping out of the wall. The fire alarm was sent in and the fellows woke up. Nine pieces of apparatus responded and the firemen ran five lines of hose into the house. Traffic was stopped on Michigan avenue due to the formation of ice on the street. The house was immediately turned into a swimming pool, and the fellows did not have much more than swimming suits on, perhaps some less, except Mooch, who reported with even a bow tie on, and Whitcomb who was busy looking for a comb. During this time the firemen were wielding a wicked ax. As a result we are minus one partition from the basement to the roof. Pipes as well as wires were also taken along with the wall. Pledges Weber and Hamlett were the heaviest individual losers. The fellows were sick for several days after and did not enjoy Thanksgiving as much as they might have. All the fraternities were mighty nice in their offers to aid us in the hour of need and this opportunity is taken to thank them for their generous invitations to take care of our fellows. We believe that the Fire Protects have had plenty of practical experience. This incident will prevent our social affairs at the house for the time being but they will be continued soon.

THETA XI

On Sunday afternoon, November 9, we were hosts to the families of our resident brothers at an informal reception and inspection visit through the house. It has also been our pleasure to entertain several of the out-of-town parents before and since that date. Brother R. M. Triest, our traveling secretary, was here for a week's visit while on his Western inspection trip. On Wednesday evening before Thanksgiving, the pledges of Alpha Gamma gave the actives an informal party. The music was kindly furnished by the Edgewater Orioles, Isham Jones, and Fred Hamm's Terrace Garden orchestra. Mrs. Clark from the Villa House of N. K. E. C. was our chaperon.

December 13 is a date which will stay long in the memory of every alumnus, active, and pledge present at that time. It was the date of the long awaited Alumni Smoker. A few of the special acts put on for the entertainment were a male quartet that was really worth while, good music by our band, boxing matches, and, of course, the buffet dinner with the usual after session of toasts and inspiring talks from many of our honorary members.

PHI PI PHI

Since last our organization appeared upon these pages, our house dance has been the most important event. It was held at the chapter house upon November 8, the day of the Illinois-Chicago football game. Many members of the Illinois Chapter enjoyed the dance with us.

We held an Alumni Smoker on November 14, and entertained the Old Boys from "way back" who were glad to be here and renew acquaintances. A stunt show was arranged by the pledges and they entertained us royally for a time.

Two theater parties were held at the Greenwich Village and Ziegfeld Follies, where a riot was almost started by a three-foot telescope brought by one of the fellows.

Phi Pi Phi wishes to extend to the faculty and students of Armour Institute, very best wishes for the new year.

PHI KAPPA SIGMA

Alphi Epsilon of Phi Kappa Sigma, with the Chicago and Northwestern Chapters, on Friday, October 17, played host to its Grand Officers. The Grand Officers arrived in town early in the morning and had not only the pleasure of meeting the active members, but the honor of meeting Dr. H. M. Raymond. The day was the seventy-fourth anniversary of the founding of the fraternity and was celebrated by the alumni and active men of the middle west at the Allerton Club. Alpha Epsilon turned out with a roll call indicating one hundred per cent of the chapter.

A Hard Times Party commemorated Hallowe'en and appropriate costuming and decoration made the affair a huge success.

Alpha Epsilon realizes that fundamentally its existence depends upon the fathers and mothers. With this in mind and the desire to show to their parents, their home at school, they held open house on Sunday afternoon, November 1. The Chapter was honored with the presence of Dean and Mrs. Monin, and Dr. and Mrs. Campbell.

Alpha Epsilon greets the New Year with enthusiasm and wishes the best of success to all the fraternities at Armour Institute.

TRIANGLE

On November 15, after a week of merrymaking, five men were initiated into Triangle. They are:

J. C. Harrower
J. P. Halama
C. H. Gambell
J. R. Zwiers
J. R. Marshall

An initiation banquet at the Cooper-Carlton Hotel, a house dance before the Christmas holidays, a theater party, and a smoker, all led up to the Annual New Year's Eve Party. Confetti, serpentines, and an excess of energy made this affair the red letter event of the season. There was something happening every minute and, believe us, the happenings will not be forgotten for many a day.

During the last month John Sweeney, Bob Mayo, and Louis Allaire dropped in to wish us a prosperous new year.

DELTA TAU DELTA

Inasmuch as the Delt news was too late to make the last issue of The Armour Engineer, the chapter wishes to announce the pledging of the following men:

F. Davis
A. Danziger
R. Cumming
A. Millott
J. Nash
G. Tucker
S. Stetler
P. Graf
P. Pinchard
G. Gustafson

We are glad to have pledge Nash back with us again. He was forced to give up school this semester, due to the time lost in confinement following his operation. He has fully recovered and is already making plans to re-enter next semester.

The annual pledge party has become one of our most popular social events, and the highest compliment that can be paid to this year's pledge group is to say that they have without doubt set a standard for this affair that will be difficult to maintain in the future.

We also wish to announce that the chapter is now located in the Lakota Hotel, which is to serve in the capacity of temporary quarters until we gain possession of our new and permanent home.

(Continued on page 74)

RECENT DEVELOPMENTS IN BOILER FEED WATER TREATMENT

(Continued from page 50)

As there is nothing in or around the boiler tubes except clear soft water, which cannot form scale, the theoretically best results as to evaporation are obtained, and further, since the temperature of the boiler feed water is within the control of the operator, the Zeolite treatment usually being done cold, the application of economizers is justified since the boiler feed water can be put in the economizer at a temperature just sufficiently greater than that which will cause deposit of dew on the outside, and therefore by having considerable temperature differential the full effect of the economizer is had.

The comparatively small space occupied by a Zeolite softener is another great advantage. A plant with a capacity of 10,000 gallons per hour for the average hardness of 10 grains per gallon requires a Zeolite softener approximately 10 feet in diameter by 10 feet high. This can usually be placed in an existing room: the plant operating under pressure.

Regarding the cost per thousand gallons of softening by the Zeolite and precipitation process, this depends on the local market prices of hydrate of lime, soda ash and salt, and on the composition of the hard water.

The market prices today average about 3/4c per lb. for hydrate of lime; 2 1/2c per lb. for soda-ash and 1/10c per lb. for salt. One pound of hydrate of lime added to 1,000 gallons will react with about 8 grains per gallon of temporary hardness. One pound of soda ash added to 1,000 gallons will react with about 6 grains per gallon of permanent hardness. One pound of salt will regenerate a volume of Zeolite that has softened a thousand gallons of water containing about 2 grains per gallon of either temporary or permanent hardness. Therefore, for temporary hardness: 1 lb. lime at 3/4c reacts with 8 grains, or about 1/10c per grain; 1 lb. salt at 1/10c reacts with 2 grains, or about 2/10c per grain. Lime treatment is therefore half as costly as Zeolite softening for temporary hardness. For permanent hardness: 1 lb. soda ash at 2 1/2c reacts with 6 grains, or about 4/10c per grain; 1 lb. salt at 4/10c reacts with 2 grains, or about 2/10c per grain. Soda ash treatment is therefore twice as costly as Zeolite softening for permanent hardness. Waters therefore which contain equal amounts of temporary and permanent hardness can be treated at the same cost by either method. But as the permanent hardness rises in proportion to the temporary hardness softening becomes more economical by the Zeolite process.

In making the above calculations no account has been taken of the fact that softening with lime and soda ash leaves 4 to 5 grains of hardness in the treated water. For example, if the raw water has an average of 14 grains per gallon of hardness, of which 8 grains may be temporary and 6 permanent, the lime and soda ash cost of treatment is about 3 1/4c per thousand gallons. But if 4 grains are left in the soft water, only 10 grains have been removed so that per grain of hardness removed the cost is 0.325c. The same water would be totally softened by the Zeolite process for about 2.8c per 1000 gal., which establishes a cost of 0.2c per grain of hardness removed.

When the quantities of water to be softened are very large, and when the temporary hardness is high, a combination of the Precipitation and Zeolite system is essential and economical. A number of such plants have been installed. Many Zeolite softeners have been added to existing precipitation plants to get uniform Zero water at a minimum cost for installation.

THE TANTALUM ELECTROLYTIC VALVE

(Continued from page 56)

simply ceases to operate. The addition of water will cause it to resume charging in the normal manner. This type of cell will carry from 2.5 to 3 amperes continuously without heating and will stand overloads of short duration of several times this value.

There are many places where a simple device which would deliver continuous current from an a-c. power supply is very desirable. Foremost among these in the popular mind is the plate current supply for radio sets. A rectifier for this purpose is now being marketed under the name of Balkite "B". It consists of a transformer, rectifier cells and a filter made up of a choke coil and condensers. The Balkite "B" will deliver 20 milliamperes at 90 volts, 12 milliamperes at 50 volts, and 0.6 milliamperes at approximately 20 volts. By moving the tap switch an output of 50 milliamperes at 90 volts or 20 milliamperes at 115 volts can be obtained. The output is practically pure continuous current and will not cause a hum in a telephone receiver. In this connection it might be noted that an oscillograph is not sufficiently sensitive to detect irregularities in the output which would cause serious noise trouble in a telephone receiver. An oscillograph would give a straight line record on a current wave which would cause a very pronounced howl in a telephone receiver. In such service, the power required is very small, only 10 watts being drawn from the line. The output on the 50- and 20-volt taps is controlled by resistances connected as shown. This has proven more satisfactory than transformer taps because it simplifies the filter circuit. It has been found that the high resistance used on the 20-volt (detector) tap has an inherent regulating effect and makes the use of a variable resistance in this circuit unnecessary. Other outfits similar in principle to the one described are used to furnish direct current for telephone loud speakers and telephone selector switches.

In some installations of storage batteries, particularly in central stations, it is customary to charge the battery from a direct current bus. The battery is often used for the supply of current in emergencies and it is therefore necessary to provide an automatic means for disconnecting the battery from the bus in the event of power failure on the bus in order to prevent the battery from discharging on the line. Relays are commonly used for this purpose. However, they sometimes give trouble on account of sticking. If a tantalum valve cell is connected in series with the battery and the proper resistances across the line, the current will be able to flow into but not out of the battery. This makes a current check which cannot stick or get out of order. The maximum voltage which one cell can safely check is 60. Cells must be connected in series to function on higher voltages. The resistance of such a cell to d-c. is 0.3 ohm and it sets up a counter e.m.f. of approximately 3.0 volts. Check cells may possibly find many other uses, as, for instance, limiting stray currents in cable sheaths and cutting down induced currents in telegraph lines.

In conclusion, it can be truly said that the possibilities of the tantalum rectifier have just been touched. The electrolytic rectifier possesses many advantages which make it particularly adapted to many kinds of service and, with the assurance of absolute reliability, it should rapidly come into wide use.

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ATTENTION, CHEMICALS!

(Continued from page 63)

are afforded the most favorable opportunities for observation of the present system, for experiment upon themselves, and for the recording of impressions which may later be tested in the light of new experiences in the world. Progress in engineering education is directly proportional to the interest displayed by the engineering student in the problems that center about his own technical and cultural training. To deliberately slight the cultural subjects which are offered is to seriously impair the chance to live the most satisfactory type of life possible. To deny the available sources of first hand information and the benefits of constructive suggestion to the cause of liberal education is to defy progress and to court decay.

FRATERNITIES

(Continued from page 72)

BETA PSI

The Beta chapter of Beta Psi National Fraternity has moved into its new home at 3328 So. Michigan Ave. During December we were visited by the following members of the alumni: Everett Hanson, Henry Karow, Chester Shaffer, and Ray Grahn. Some are supporting families and all have responsible positions.

Since the last issue of The Armour Engineer, the following men have been pledged:

M. L. Landreth
A. F. Hibbler
C. W. Price
M. T. Goetz
F. C. Steinhaus
O. C. Kempf
H. W. Ohlhaver

During December we entertained the Chicago Alumni Chapter at dinner and the delegates to the National Convention which was held in Chicago. Everyone had a very good time.

UMEN RADIO DANCE

Social activities of the Umen began on October 3, with a smoker at which a number of our alumni were present. This was followed by another on October 17, and a Hallowe'en Party on November 1.

The outstanding affair was a Thanksgiving Party held on November 27. A well balanced program was presented and the entertainment was a complete success.

The entertainment consisted of several vocal selections by a well-known radio artist, violin selections by Frater Samuels, and several other good and entertaining numbers. The dance music was furnished by Jack Chapman and his Drake Hotel Orchestra, a la radio.

It may also interest you to know that we have acquired a thirty-eight foot sailboat, twice winner in the Chicago-Michigan City races in its respective class. Many healthful and enjoyable trips were experienced by the Fraters this summer.

In addition we wish to announce the pledging of the following men:

J. Weinberg
J. J. Reifler
B. Herzon
M. Goldstein
C. Shparago
R. L. Conney

RHO DELTA RHO

The semester, now well advanced brings with it joys and sorrows—joys from outside activities and sorrow from the Dean's Office. A smoker held on October 18, gave some of our ambitious pledges an added opportunity for exercise and originality. The feature of our Thanksgiving Party was a novel table decoration. All viands were emblematic of something for which we were thankful. Campbell's Calculus was not represented.

Rho Delta Rho wishes to announce the pledging of the following men:

S. Cohen '28
M. Reiger '28
H. Ginsburg '28
A. Weisberg '28

She—"Oh, John, you always have been so strong, brave, and self reliant. What made you that way?"

He—"You exaggerate my dear; but I will admit that I took Physics Lab. at Armour."

To be sung to the tune of "Comin' Thru the Rye":

Of all the trains upon the "L"
The one they ride the most,
Is nothing but the trains that hold
The Normal College host.

The ARMOUR ENGINEER

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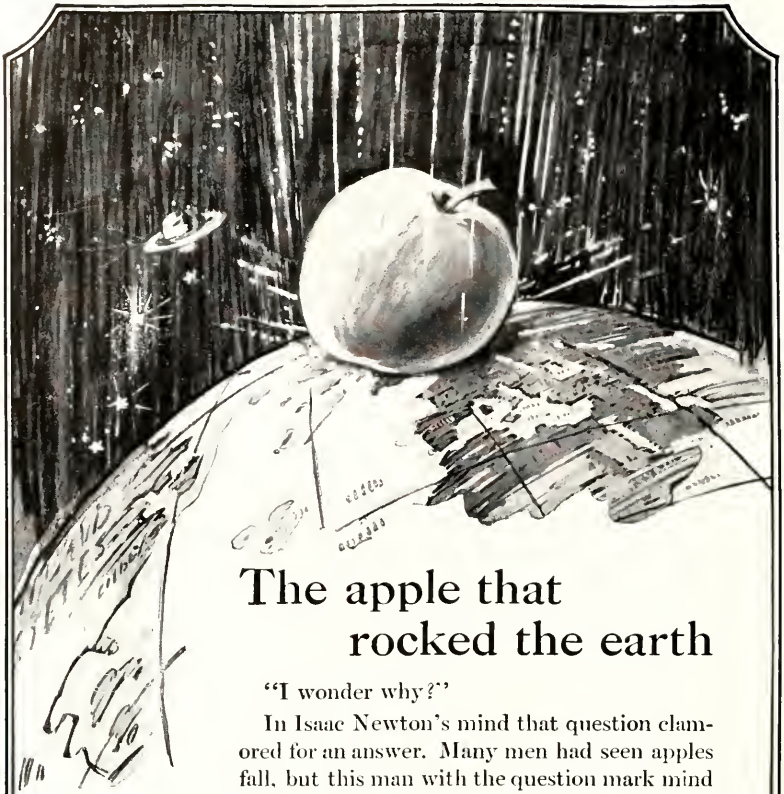

The apple that rocked the earth

"I wonder why?"

In Isaac Newton's mind that question clamored for an answer. Many men had seen apples fall, but this man with the question mark mind found out why they fall—and his answer has helped us to understand the workings of a universe.

Would that we all could get a bite of that apple if it would inspire us too with the "I wonder why" attitude!

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THE
ARMOUR ENGINEER

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OUR NATIONAL DEFENSE POLICY

By

CHARLES L. BOLTÉ, '17

Captain, United States Army

OUR country has experienced a healthy recovery from the terrific strain imposed upon it by the World War, and can safely be said to be back in its normal peace-time channel of progress. The emotion and hysteria which war engenders have disappeared, and we can be counted upon to view our position in world affairs with equanimity. Such a process must of necessity involve a consideration of the need for a plan of national defense and for a sound policy under which that plan can be administered. In this connection it is of interest to trace the history of our methods of defense in their relation to our national development and to our present defense policy.

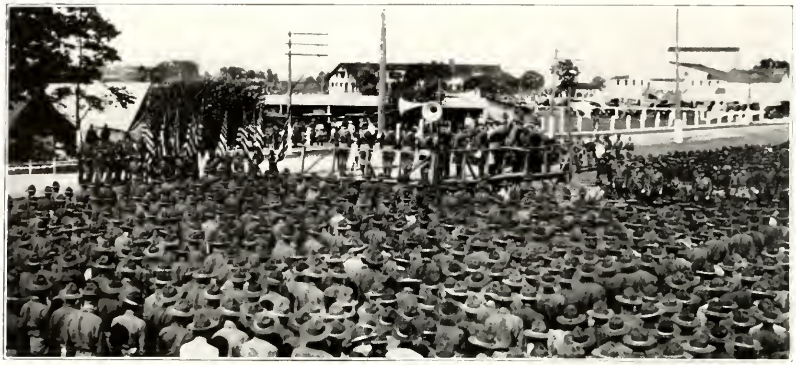
The early colonists soon realized that common interests and the commercial inter-dependence upon which their very existence was based necessitated mutual efforts toward their defense. Realizing the waste and ineffectiveness resulting from the individual attempts of each colony to protect itself, the New England colonies in 1643 formed a Confederation, with the main purpose of providing "a firm and perpetual league of friendship and amity for offense and defense." Under its articles the colonies agreed that the cost of wars justly involving any of them should be borne by all of them and pro-rated according to the number of their free male inhabitants between 16 and 60 years of age. In enacting this agreement, the colonists were but following a precedent known to their ancestors in England since the eleventh century. A statute then required that every free man between the ages of 15 and 60 possess arms and armor to preserve the peace, but protected him from having to leave his county or shire, save upon invasion of the realm. In other words, it was an attempt at adequate provision for national defense.

Capt. Charles L. Bolte.

The people of the United States, after establishing their independence from British sovereignty, were faced with the problem of self-government. In 1787 the Constitution, which has been and now is the cornerstone of our government, was drafted and put into effect. Its purpose, succinctly stated in the brief preamble, is to form a more perfect union, establish justice, insure domestic tranquility, provide for the common defense, promote the general welfare, and secure the blessings of liberty to the people of the United States and to their posterity. It gives to the constituted Congress certain powers. Among them is the power to raise and support armies and to provide for the calling forth of the militia to execute the laws of the Union, to suppress insurrection, and to repel invasion. It is important to notice that this power and the power to declare war were conferred upon Congress not for purposes of aggression or aggrandizement, but to enable the general government to vindicate its own rights and those of its citizens. It can not be presumed that a war declared by Congress is waged for purposes of conquest. Our nation is not aggressive. On the contrary, since our forefathers first established themselves upon these shores and then threw off the yoke of tyrannical oppression, our country has ever stood for freedom, liberty, and self-government. Its inherent tradition stands firmly for the defense of our national integrity, and is unalterably opposed to aggression, either by the United States or against it.

It requires no detailed study of our history, however, to disclose the fact that until the passage of the National Defense Act in 1920, the legislative provisions for our national defense have followed a hit-or-miss course. The Colonies began to make preparations for armed conflict with Great Britain as early as 1774. The militia was organized into companies and regiments, and a portion of these into "minute men." Three days after the battle of Lexington, the Continental Congress, although it possessed only an advisory power, authorized the raising of an army of thirty thousand. Ability to enlist men was the sole qualification for command—a vicious system which prevailed at the beginning of all our wars for more than a century. A captain's commission was given to the man who could raise a company of 59 men.

Two weeks after the battle of Bunker Hill, fought by raw troops officered by veterans of the French and Indian Wars, General Washington assumed command of the Continental Army. From then on he was confronted with the problem of maintaining an effective force, constantly having to recruit men to take the place of those whose short terms of enlistment expired. The new-made soldiers soon grew tired of their tasks and departed for their homes by the hundreds. Desertions were wholesale, and furloughs and bounties were resorted to in order to keep the ranks filled. Re-enlistments were slow, and it was only with great difficulty that Washington maintained his army. He practically disbanded one army and recruited another—all within musket shot of the British lines about Boston. This condition prevailed throughout the Revolutionary period. During that time the several states furnished to the Continental Army a total of less than four hundred thousand men. Against these the British had at no time over forty-two thousand on this side of the Atlantic. In 1776, for example, the American forces numbered during the year ninety thousand, the British twenty thousand. The fault lay not in the quality or character of the men, but in the lack of foresight and preparation, and in their consequent inefficiency.



Oath of Allegiance Day.

The period from the close of the Revolution to the outbreak of the War of 1812 was one of defenselessness, so far as any considerable organization for defense was concerned. In 1781 the entire Continental Army was disbanded save for 80 soldiers left to guard stores. Between 1785 and 1812 the regular force fluctuated between 700 and 5,000. Six months before the war of 1812, Congress authorized a paper increase to thirty-five thousand, but in spite of this, on the declaration of war, the army numbered less than seven thousand, as against Great Britain's five thousand, then in Canada. During 1812 not less than sixty-five thousand men drew government pay in the Army, and, in 1813, one hundred and fifty thousand. During the entire war five hundred and twenty-seven thousand troops were in service, and yet the largest opposing British force numbered less than seventeen thousand.

To give a comprehensive picture of our lack of a policy for defense, it is necessary to employ these figures. In this manner there is illustrated a proper conception of the vast waste of time, money, and lives resulting from the want of a clearly defined, adequate, and efficient military policy. The career of the militia during the War of 1812 presents a picture of failure seldom equalled by troops of any country, and this was wholly due to a lack of preparation for the task which fell to them. They were without discipline, discontented, badly officered, and miserably provided with everything which was essential to their utility. Hull's surrender of Michigan Territory without a battle; Van Rensselaer's sacrifice of an army at Queenstown through inability to control his militia; the ignominious dismissal of his successor, Smyth; the defection of the militia at Bladensburg in the presence of the President and his Cabinet, followed by the burning of the Capitol and Executive Mansion; all are indicative of the price which must ultimately be paid when armed conflict occurs for which the country is unprepared.

The lack of a proper military policy was not characterized by any consistency in organization. Prior to the War of 1812, the Army was reorganized six times, once more in 1815, and again in 1821. The Seminole War in 1817, and the Black Hawk War in 1832 brought about increases in the regular establishment and resort to the use of the militia. In the Florida War, from 1835 to 1842, the total number of troops was over a hundred thousand, and yet at no time did the forces in service ever exceed nine thousand. For want of a well-defined policy and expansible peace-time organization, a nation of seventeen million population contended for seven years with twelve hundred Indian warriors, and finally closed the struggle without forcing the emigration of the Indians, which was the sole object of the wars.

The history of our policy during the Mexican War conveys at first glance a more favorable impression. Palo Alto, Resaca de la Palma, Monterey, Buena Vista, Vera Cruz, Cerro Gordo, Contreras, Churubusco, and El Molino del Rey contributed an unbroken chain of victories preceding the entrance of our troops into Mexico City. But it is a fact that these were achieved under the same system of laws and executive orders which had led to such a series of disasters in our previous foreign struggles. The explanation of this paradox is found partly in the different character of our adversaries, but more particularly in the fact that the leaders in the Mexican War inherited troops which had been schooled by experience in the earlier conflicts. At Palo Alto and Resaca de la Palma, General Taylor defeated a hostile force of more than six thousand with two thousand troops, but they were trained men, a regular army such as was not in existence at the outbreak of the War of 1812. Later operations involved the calling for volunteers, under the old fallacious method of short term enlistments instead of for the period of the war. There were employed at one time during the war, over a hundred thousand troops. Yet Scott fought his decisive battles around Mexico City with less than ten thousand effectives and entered the capital with less than six thousand combatants.

In 1860, with a territory of three million square miles and a population of thirty-one millions, we had an army of less than seventeen thousand, and that without an expansible organization capable of absorbing and training any considerable number of recruits. Nor did we have any system of national volunteers or organized militia whereby any force other than an untrained mob could be made available within a reasonable time. The Regular Army consisting of only 198 companies, all but fifteen of which were stationed on the frontier or en route to posts west of the Mississippi. When Fort Sumter fell, the President called out the only available force—seventy-five thousand militia—for a period of three months. The

Confederacy called for a hundred thousand men to take the field, but made the same mistake of limiting their term of service in that case to twelve months. The forces asked for were wholly incommensurate for the task in hand, and were, moreover, raw levies with little or no knowledge of what was to be required of them. Before the end of the war two and three-quarters million Union soldiers were engaged.

The War with Spain found us again entirely unprepared for expanding our regular forces or for building up rapidly and efficiently a satisfactory volunteer force. We were fortunate that our adversary was not of a type to give us a more difficult time. As it was, although the war lasted only 109 days, many lives were needlessly sacrificed and much time and money was wasted because of our tardy preparations and lack of up-to-date methods and equipment. At the beginning of the war our Army numbered twenty-eight thousand. Over a quarter of a million were in service before the short conflict was ended.

This brief survey of our military history makes it plain that although the Constitution in 1787, and even the preceding Articles of Confederation in 1778, recognized the necessity for providing for the common defense based upon the right and obligation of citizens to bear arms in defense of their homes and country, over a century and a quarter passed without specification of the manner in which the means for defense were to be applied. Each war, each emergency, found us in the same state of unpreparedness, despite past experience.

In time to a stirring march.

Then came the enactment of the National Defense Act in 1920. It has given us, for the first time, a definite military policy carrying into effect the principle of obligation for service which had been recognized since the founding of the Republic but not applied.

So it is an apparent fact that all our wars have been unnecessarily costly and prolonged for want of judicious and economical preparation. In the past, until the passage of the National Defense Act, and even at the present time, there has been a strong opposition to even a small standing Army, such as is necessary to fulfill peace-time missions and to provide a nucleus of trained officers and non-commissioned officers to lead and train the citizenry before, and when, the man-power of the nation shall be called to its defense.

There has always been, in all our wars, a persistent and costly use of raw and untrained personnel—necessarily, since these were the only troops available—just as there has been a persistent unwillingness to devote a comparatively small portion of our time, effort, and wealth during peace-time to the preparation and training of our man-power for the desperate work which it might be called upon to do in time of national danger.

There has always been a total lack of an expansible organization which could be rapidly and efficiently built into an adequate force for the defense of the nation in a prospective emergency.

Prior to the World War, reliance was always placed, at the beginning of hostilities, upon short voluntary enlistments, with the attendant payment of bounties in money and land to induce men to serve in the armed forces. And all this has been in the face of the principle so vital to the existence of a democracy that every citizen owes to the Republic which protects and shelters him the individual service which the Republic needs in time of danger.

The almost insurmountable difficulties under which Washington labored during the War of the Revolution when time after time he found the ranks of his army depleted and deserted by men whose short terms of service had expired; the rout of our untrained and undisciplined forces at Bladensburg, with a loss of only 8 killed and 11 wounded; the costly months of delay endured by Scott's army before Mexico City because of the loss of short-term men; the call, under a law sixty years old, for seventy-five thousand volunteers for the limited period of three months—far less time than it takes to train a man in the rudiments of military service—to meet the forces of a population of 8,000,000 determined to disrupt the Union; all these, and many more examples, bear grim witness to the want of military policy which our nation has endured, and to the costly inapplication of the principles for national defense laid down in the Constitution by our country's founders.

Ready! Aim! Fire!

We have realized, for the first time, in the National Defense Act, a statement of our military policy which permits fulfillment of the constitutional provision for the common defense of the nation. We know that a nation which is constantly in arms, or which spends a predominant part of its income or resources on its armed forces, cannot progress nor even endure long. But it is no less certain that an unarmed and defenseless nation only invites aggression and disaster through its incapability of resisting the imposition of an alien will.

It is obvious, then, that while a nation must bend its principal effort during time of peace to its economic and commercial development, it must at the same time make adequate provision for diverting that effort to its own defense when such a need shall arise. It is

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THE GREAT AMERICAN CITY OF THE FUTURE

By

JACOB L. CRANE, JR.

City Planning Engineer, Chicago Regional Planning Board

FOR three thousand years great cities have appeared at strategic points in various parts of the world. Most of them have disappeared again. When viewed from the standpoint of normal, efficient, and agreeable environment they have all been failures. Enormous numbers of people are gathered together in cities for purposes of protection and commerce. Concentration on as small an area of land as possible made efficient business possible up to a certain point. But in every case overconcentration has produced such disagreeable, unhealthful, and ultimately inefficient results that the great cities have slackened their growth, ceased to grow, and ultimately declined.

Up until the modern period there have not been available the means for overcoming these disadvantages; we have not had the tools (transportation and communication) to reorganize these cities to meet normal human requirements. With the advent of rapid transportation and immediate direct communication we can now decentralize our great cities over much larger areas of land and so produce communities which will operate conveniently and efficiently to meet the normal requirements of our varied human activities. The future metropolis of the world we believe will be the great regional city of Chicago, developed under the guidance of the Chicago Regional Planning Board which has as its objective the utilization of modern transportation and other tools of decentralization for producing this regional city.

Everyone who asks himself about it frankly knows that the present city of Chicago is not the ideal community, "the city of gardens," that it was hoped would build up here. It has become crowded, noisy, dirty, expensive, and finally, grossly inefficient. The disadvantages of residence in the city are demonstrated by the great tide of population which has been flowing and which continues to flow out to the suburbs. That industry and commerce have become inefficient within the closely built up sections of the city itself is proven by the marked tendency for industries and commercial houses to move out and establish new plants in the outer metropolitan area. The tremendous industrial growth in the Calumet region, in Cicero and other western suburbs, and in Waukegan, illustrates the tendency for industrial decentralization. The growth of the suburban residential towns demonstrates the tendency to residential decentralization. The net result is that the territory around Chicago is building up rapidly and that the rate of growth of the city is declining. With the utilization of the most modern means of transportation and distribution of electrical power, and with the application of sound modern ideas of city planning and land development, this growth of a regional city around Chicago may be encouraged and hastened, and the resultant regional city may be much more nearly the ideal community which it was hoped that Chicago might be.

The regional city of the future as conceived by the Regional Planning Board will not be a solidly built up city with a few parks to relieve the congestion; rather, it will be a group of fifty to one hundred communities ranging in size from ten thousand to one hundred and fifty thousand, each with its own government for local affairs, but all united by a joint commission on planning and development. These secondary centers will be interconnected by systems of communication and transportation far exceeding anything imagined so far. There will be required a system of highways with traffic capacity ten or even twenty times as great as the traffic capacity of the present highway system. There will be three or four times as many radial roads from the city center, and there will be an elaborate system of circumferential roads and inter-town roads through the whole region. Furthermore the pavements will have capacity for four to six and eight lines of traffic. In general the main roads will pass near, but preferably not through, the built up towns, from which there will be direct and convenient connections to these main roads. A new system of radial highways would also be required from such important districts as the Calumet industrial region.

The rail transportation lines into the city will be supplemented with new lines and particularly with feeder lines reaching out to all parts of the region. In this field also there will be circumferential and inter-town rail transit facilities. The airplanes and possibly the dirigible will also be extensively used for rapid and light transportation. A complete and co-ordinated program of landing fields and air terminals will be necessary.

A factor of the greatest importance in this regional development is the advent of the wide distribution of high tension electric power at low rates available at all outlying industrial centers. The utilization of motor trucks over a fully developed system of heavy highways, along with the use of belt line railroads, will make it possible for industries to decentralize, that is, to move their operations to outlying points in a way that is not feasible without these facilities. The system of super-power distribution from great central stations has already been undertaken. In a comparatively short time it will be possible for an industry to get high tension power at low rates anywhere in the Chicago region.

The increasing importance of the Chicago district as a manufacturing, commercial, and residential center and the growth of population to a figure of ten or twelve million people within the next two generations will create the need for recreational facilities far beyond anything imagined up to this time. The Cook County forest preserves are a magnificent achievement and they show up very well in a map of Cook County. But when the whole Chicago region, extending from Kenosha around to Elgin, Aurora, Joliet, Kankakee, and Michigan City, is considered as developing into a single great inter-connected regional city it will be seen that parks and forest preserves on an enormous scale must be considered.

The Regional Planning Board anticipates the reclamation of the Lake Michigan water front from Kenosha all the way to Michigan City. This will have to be accomplished by building land out into the lake at many points, as is now being done in Chicago and Evanston. It is possible in this way to develop an almost continuous lake front park one hundred miles long, far greater and far more useful than any other recreational water front in the world. It is further anticipated that a total of 100,000 or even 200,000 acres of forest preserves and inland lake parks will be required. There are excellent opportunities for development of this character in the Fox Lake district, along the Fox River from Cary to Aurora, along the Kankakee River, in

(Continued on page 112)

FIRE ALARM SYSTEMS

PART I

By

CHARLES A. WHITNEY

Engineer, The National Board of Fire Underwriters

SINCE early times, man has been devising systems to quickly transmit emergency signals. All are more or less familiar with the fiery crosses of the ancient Scots, the smoke columns of the American Indian, and with semaphores, drums, and watch towers. It is not our intention at this time to go extensively into the history of the development of the electrical circuit for the transmission of alarms of fire; we shall confine ourselves mostly to the art as it exists today.

The invention of the electric telegraph by Samuel F. B. Morse in 1855 was followed by the investigations of Dr. William F. Channing of Boston and Professor Moses G. Farmer of the University of Maine, who invented the fire alarm telegraph circuit.

When the National Board actively took up the inspection and testing of fire alarm systems, beginning in 1904, there was no standard fire alarm system, although many features and devices had been standardized. The manufacturers aimed to please and would, and still do, build devices to suit the supposed needs or interests of the various cities or of the officials who are charged with operating the fire alarm systems. Many systems were of the same general type, allowing for differences in size, yet practically no two of those in use were alike in all respects. A need was felt for some standard to which inspectors, city officials, manufacturers, and others could refer when planning new systems or improvements in existing ones. In due time the matter of standards was given consideration, and was referred to the Signaling Committee of the National Fire Protection Association, which, about 1908, produced the first rules and regulations to govern the installations of fire alarm systems. These have been revised several times, the last revision appearing in 1922. These regulations are now an important guide in describing the functions of a fire alarm system, and are at times made a part of the actual specifications.

The National Fire Protection Association says that a fire alarm system for municipal purposes should be so designed, installed, and maintained that "alarms may at all times and under the most adverse conditions, be promptly transmitted to the fire department. To this end, attention is called to the supreme desirability of providing headquarters which, as far as practicable, will be free from liability of damage by fire, either from internal or external causes; of installing apparatus suited for promptly and correctly transmitting alarms, but which will be simple of operation and easy of maintenance; of placing all wires outside of buildings, as far as practicable, underground; of having frequent and systematic tests of all apparatus; and of having in charge of such systems only men of known judgment and ability." To meet the requirements of various sized cities, fire alarm systems have been placed in three classes:

Mr. Charles A. Whitney.

Class A.—Manually-operated Systems: The manually-operated systems may be used for cities of any size, and are required when seventeen or more box circuits are needed, or when four hundred alarms are received per year. A manual system is one in which the manually-operated facilities in the central office receive signals on audible, visual, and registering devices, and transfer them to the outgoing circuits to the fire station. The need for a manual system usually occurs when a city reaches a population of about 100,000. In cities of this size it is not uncommon to receive simultaneous alarms from widely separated sections. The manual feature is intended as a means of separating these alarms, thus preventing the loss of one alarm; to handle the many features incidental to the moving of a large number of fire companies at a serious fire; and for testing purposes.

Class B.—Automatic Repeating Systems: An automatic repeating system is one in which the signals are automatically transferred from the box circuit on which they originate to all box circuits and alarm circuits. An automatic system is required for systems needing more than one, and less than seventeen box circuits, and having less than four hundred alarms per year. In cities under 100,000 population, there are usually not enough alarms and there is not sufficient testing to be done to call for constant attendance of an operator.

Class C.—Automatic Non-repeating Systems: These may be installed in small communities needing but one box circuit and a very few boxes. In a system of this type only one circuit is used, and all boxes and alarm instruments are connected in series.

There are certain features which are general, and may be found in any one of the three types of systems. They are boxes, circuits, wiring, circuit protection, current supply, and central station building. Starting with the street box at which the alarm originates, each feature will be taken up in turn.

The general exterior appearance of the fire alarm box is more or less familiar to all. First there is the outer case or shell with the pointed top; second, the inner box enclosing the box movement. Briefly, this is a transmitter with a code wheel, driven by a clock movement, and so connected to an electrical circuit that it transmits a predetermined signal over the circuit. Boxes now in use are of three general types: interfering, non-interfering, and successive. These, however, are quite similar in certain characteristics. They may be either spring- or weight-actuated. For several years only the spring-actuated type of box has been manufactured to any extent, although a few weight-actuated boxes are still in use. Spring-actuated boxes may be of either unwound or pre-wound type. In the pre-wound type the box must be wound up after every alarm, in order to be ready for the next call. The pre-wound type has the advantage that, if operating at all, four rounds must come in. On the other hand, it may be run down when needed, without warning being given, especially if of the non-interfering or succession type. The normally unwound box may send in from one to four rounds, according to how hard the handle is pulled. If the person giving the alarm understands the mechanism, he will of course send in the full four rounds. If he does not understand, he will probably be somewhat excited and will pull it hard enough to send in three or four rounds. For the interfering and non-interfering boxes, the unwound box of sector pull type is generally preferred. For succession boxes the pre-wound box with trigger pull is generally preferred. The sector pull consists of a lever, usually about four inches long, operating through an arc of 60 to 90 degrees, generally in a vertical plane. The trigger pull consists of a small hook on bar, with a short movement, perhaps one-half inch, which simply releases an interior lever of a pre-wound box. The amount of force required in either case is slight, so that a 10-year-old child can readily operate either type.

Key door box.

Do you know how to send a fire alarm? The most elaborate fire alarm system a community can install offers inadequate protection unless its citizens are acquainted with the location and operation of the boxes.

Break-glass type.

All four types of door release described by Mr. Whitney may be found in Chicago. The box opened with a key is perhaps the most common in the residential districts of the city. The key is usually kept in the nearest drug store. Since keys are easily lost or misplaced, recent installations have favored the keyless door which opens when the lever handle on the outside is turned. Theater boxes, located in front of all downtown theaters, are opened by a strong pull on the door handle. The break-glass type of release is comparatively rare. Whatever the type of box may be, it must be remembered that opening the door does not send in the alarm, even though, as in the turn-handle type, a bell within the box may ring. The lever or hook within the box must be pulled and released.

For the purpose of obtaining the greatest possible efficiency from our fire alarm system, we offer the following suggestions: Locate the nearest fire alarm box to home, office, or school. Do this now. Telephone service was not designed for emergency calls. The telephone has other work to do. In case of fire, send in an alarm promptly. Open the door of the box, "pull the hook way down and let go." Remain at the box until the fire company responds to the call. Otherwise valuable time may be lost in locating the fire. The "little red box on the corner" protects your life and property. Learn how to use it!

Turn-handle box.

Theater box.

The accepted standard type of box sends in four rounds. Long experience has determined that this is the most satisfactory movement for general purposes, and it has been recommended by underwriting organizations and ordered by state bureaus which have made regulations for fire alarm protection of factories, schools, hospitals, and other institutions. The reason for multiple rounds from the box is to give verification of the signal being received. An operator or fire company generally waits for the receipt of the second round before moving to re-transmit or respond to fires, and when there is a difference between the first and second round, the third round is waited for.

Only boxes operated on normally-closed circuits are approved. Obviously, only a normally-closed circuit can give instant notice of a break, the trouble which most often renders a telegraphic circuit inoperative. Modern fire alarm circuits generally operate on a normal current of not over 100 milliamperes and not over 60 volts.

The plain interfering type of box consists essentially of a main spring, similar to a clock spring, trains of three or four gear wheels and escapement, a code wheel attached to the shaft of one of the gears, and break-contacts operated by the code wheel, which open and close an electric circuit. When the lever is pulled or the trigger released, the spring or weight causes the gears of the clock to turn, communicating the motion to the code wheel, which rotates for four rounds and sends a signal corresponding to notches or teeth on its periphery, over the electrical circuit. For fire alarm apparatus the notches are usually equal so that to a person listening to the receiving mechanism, signals are received as a series of clicks or blows. To one looking at the register, they appear as a row of punches or dashes on the tape. When gongs or similar sounding pieces of apparatus are connected to the circuit they are struck at regular intervals.

"Local non-interference" or "non-interfering" pull is produced by so arranging the pull lever or trigger that after once pulling and releasing, it is impossible to manipulate the handle or trigger so as to interfere with the clock-work until the box has completed its cycle of rounds.

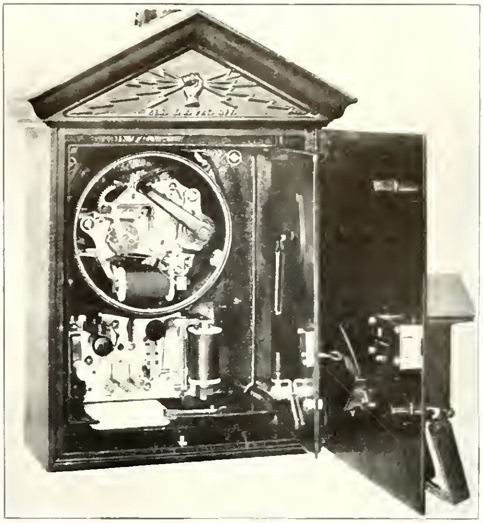
To produce non-interference between boxes, there is added to the plain box a magnetic coil with armature which tends to drop whenever a circuit is opened, either at the box in which it is installed, or at any other point. If the opening is caused by the box itself, then mechanical means in connection hold the armature up so that the box stays in circuit. If the opening is caused by another box on the circuit or by a break in the wire, then the armature drops and the box becomes inoperative until the circuit is restored. This prevents the operation of the second box while a previous box is still operating, and prevents the interfering of signals. Generally the operating lever is so arranged that when the armature has dropped, the lever is either loose on the shaft or locked in place so that it cannot be operated or, if operated, will produce no effect.

"Distance non-interference" may be of two kinds. According to its construction, the box may be positively non-interfering so that the first box pulled will hold the circuit and keep all others out until it has finished its cycle, or it may be partially non-interfering and successive so that when two boxes are pulled, the one first gaining control will hold until the completion of one round. Then the first box of the two to begin the second round will take control, and so on; thus the box having the shorter code number will generally gain control at the end of the first, second, or third round, and send in the remaining rounds. This in some respects is an advantage in that it gives the fire department notice that two boxes have been pulled.

The succession box, which is the generally more acceptable type, has in addition to non-interference a mechanism so arranged that a second box, pulled while a box is still operating, will be automatically locked out until the first box has finished. It will then be permitted to transmit its signal. This has been carried so far in some types of boxes that as many as four may be pulled nearly or quite simultaneously and they will all come in, one after another.

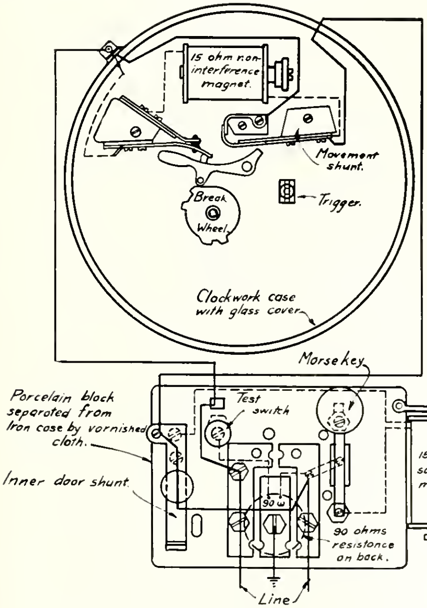
The break-contacts of fire alarm boxes are an important feature. Formerly many boxes broke contact by applying one side of the circuit to the break-wheel and the other side to flexible metallic fingers or brushes which rubbed against the periphery of the break-wheel and dropped into the notches, thus making the code signal. On account of arcing, corrosion, etc., these were found not to be durable, and were accordingly unreliable. It is the practice now to use flexible metallic fingers having silver point contacts, similar to the contact points of the Morse key and ordinarily known as key breaks. These are arranged so that current goes from one spring finger to another and the break-wheel itself does not carry current.

In addition to the simple mechanism described above, there are generally included in the boxes intended for outside use, a small Morse key for transmitting code signals other than the signal of the box, a ground plate for testing purposes, a door shunt for protecting the interior mechanism from lightning or high-tension current, binding posts for quick connection of the circuit wires, and sometimes a telephone jack for the insertion of a portable telephone set into the line.



Courtesy the Gamewell Co.

Peerless Sector Box. Pulling the hook all the way down winds the mechanism and sends in four rounds of the signal. The starting lever projects through a slot in the inner door.


15 ohm non-interference magnet.
Movement shunt.
Break Wheel.
Trigger.
Clockwork case with glass cover.
Morse key.
Test switch
Porcelain block separated from iron case by varnished cloth.
Inner door shunt.
90 ω
15 ohm sounder magnet.
90 ohms resistance on back.
Line

Courtesy National Board of Fire Underwriters

Box circuit of a non-interfering box. Note the approved form of key break. The break wheel carries no current.

In order that the internal mechanism will be properly protected from injury and atmospheric deterioration, street boxes are kept locked. In order to make the releasing mechanism easily and quickly available to the public, various types of door releases have been devised. First, the key may be retained in the door by means of a trap lock. Second, this key may be protected by a glass guard which necessitates the breaking of the glass to gain access to the key. Third, the box may be equipped with a keyless door which has a lever handle on the outside, intended to be turned until a large bell on the inside of the door rings. The turning of the handle operates this gong and notifies persons in the vicinity that the box is being opened. With this type of door, the turning of the handle may be made to trap the releasing mechanism of the box, or the person may pull the hook. Fourth, release may be effected by a pull handle, in which the trigger is guarded by glass or non-breakable glass. A strong pull on the handle gives access to the trigger.

Next to the type of box, the features of conspicuousness and accessibility are most important. It is a frequent occurrence that the average citizen does not know where the nearest box is located or, having found it, how to operate it. Therefore it is necessary to make the boxes so conspicuous that the excited person whose house is on fire cannot help but see the box when he approaches it, and will not run past four boxes on his way to an engine house, as has happened many times. For conspicuousness, a bright red paint appears to fill the bill. It should be applied often enough to keep the box bright. When the box is on a pole, a broad band around the pole is needed, as from some directions the box is invisible. In one of the southern states a bright yellow is coming into use as a fire alarm box paint..

Another feature that is of importance in thickly built districts is a red light to indicate box location. This need not be directly on the fire alarm box post. With the general introduction of the curb electroliers or "white way" lighting, it is sufficient to have a red globe on the nearest electrolier. Some cities have put a red band on one

(Continued on page [illegible])

THE IMPORTANCE OF FINANCIAL TRAINING

By

CARL HEIM, '09

DON'T be alarmed if someone should come to you in the last semester of your senior year and tell you that your chances of becoming an engineer, or even being remotely connected with the profession are less than twenty-five per cent. Most of us, upon entering college, are very much inclined to believe that we have chosen exactly the line of endeavor that we wish to adhere to for the balance of our lives. We spend the four years at college pondering a great deal as to whether we are going to make a success or not of that particular course which we have selected. Most of us are unmindful of the fact that what is more important to us than anything else is that our college training is really only the ground work for the education and experience which is to follow; and that it will be equally invaluable, regardless of what our field of endeavor may be, if we lay that foundation properly, and procure the profits from such a course that any good educational training will give.

I believe it was Dr. Frank Crane who made the statement, that a well educated man is not one who knows a great deal and carries a veritable encyclopaedia of facts around with him, but one who is able to classify his knowledge; one who is able to know what he should have in his mind, and what he should not; and also one who is in a position to know exactly where to get facts and figures when he needs them. Most of us forget how to integrate and differentiate after being out of school for a number of years, but the power to solve problems, which we acquired when we were wrestling with calculus, always stands one in good stead in a business career no matter what particular commercial enterprise we are engaged in.

Although the needs of the present day make it practically a paramount necessity for the young man who wants to forge to the front among his fellows to specialize in his training and pick out some particular field which he believes to be his own, nevertheless, I feel that we can perhaps overdo this to a certain extent. Thus, as we develop into business men, we might be very efficient in a sales capacity, engineering capacity, or in a manufacturing capacity, but know nothing at all of the credit side of business, or the financing of a business enterprise, or our qualifications might be just the reverse.

It is not the purpose of this short article to deprecate the value of specialization of study in a very definite manner. It is intended as a warning to the young man who might be so overzealous in the course which he is pursuing as to entirely neglect and disregard the essential complements to the technical training which he is procuring.

Mr. Carl Heim.

There is a very vital need, it seems to me, for engineers to know something about economics, currency and finance, capital requirements of corporations, and good banking practice, in order to broaden the scope of their qualifications, and better fit them for the executive positions in business which a great many of our technical college students are bound to attain.

I have spent a good deal of time in the past 15 years with manufacturers, engineers, builders, merchandisers, and men who were "hewing right to the line." I have discovered that a very large percentage of men with whom I have come in contact have been able, very able, in their particular field, i. e., they were very expert engineers, or gifted in advertising and merchandising their products, or showed unusual ability in constructing industrial plants, or could produce the best articles in their line of business by reason of very modern equipment—but I have found almost all of these men in industry woefully lacking in their capacity to coordinate their abilities in their special line of business, with *good financial practice.*

If we are entering the commercial world with the purpose of becoming successful, we must achieve something whether we are in the business of building bridges, operating a foundry, running a printing plant, or selling kitchen stoves. And success, in the business sense, is to conduct an enterprise in a manner that will show a profit at the end of a given period. In my years of contact with business institutions that have become "sick" financially, I have learned facts that would be of unusual assistance for the average college man to consider, and to apply as a test as to his own ability in this direction.

An engineer, with a highly specialized training, developing into a manufacturer, a head of a construction corporation, a builder or even remaining as a technical engineer, is very prone to pay too much attention to his special art to the detriment of his business education and skill. In over 25 of the last 30 large industries which I have examined in order to avert what seemed like bankruptcy, I have found such characteristic ailments as the following.

1. Concern never had any kind of a cost system.
2. Amount of inventory wholly disproportionate to the needs of company.
3. Credit system handled in such a loose manner as to cause wholesale losses.
4. Head of the corporation knew only the selling and manufacturing end of the business; never bothered about financial end; left that to his bookkeeper.
5. Owner was a mechanical genius—could manufacture his product on a "production basis"—spent more than 5 years' possible profit to get on a production basis—then overproduced because he was not in touch with the financial condition of the country—and failed.
6. High grade engineer operating a chain of plants, spent all available borrowed money to install machin-

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TRANSMITTING EQUIPMENT
FOR RADIO TELEPHONE BROADCASTING

PART I
GENERAL TRANSMISSION CONSIDERATIONS

By
EDWARD L. NELSON, '14
Electrical Engineer, the Western Electric Company

ONE of the most remarkable industrial developments of recent times is the advent of Radio Telephone Broadcasting, which within three short years has grown into a matter of national importance, supporting an industry that is a veritable infant prodigy. That a tremendous popular enthusiasm for this new art has been aroused cannot be denied. No better evidence is available than the fact that, in the face of an economic outlook which is indefinite, to say the least, some five hundred stations are now in operation, many of them representing investments of tens of thousands of dollars.

Several factors have apparently contributed toward this rapid growth. In the early stages, no doubt, the novelty of the experience was of considerable importance. The discovery of the possibilities of this modern "magic carpet" exerts a powerful stimulative influence upon the imagination which is not easily forgotten. The fact that radio presents qualities which render it ideal as a hobby has also undoubtedly aided. There are few fields in which equally satisfying results can be obtained at the expenditure of so little effort and expense while, on the other hand, consistently good performance demands a high degree of skill and more or less elaborate equipment so that interest is likely to be sustained. A more important element than either of the foregoing, however, is believed to be a keen appreciation on the part of an increasing proportion of the public of what radio is and may become as a medium of education and entertainment. The already demonstrated possibility of establishing direct personal contact with the world's most gifted minds, of hearing the greatest artists and the most renowned musical organizations, of sitting at the banquet table with leaders in every field of human activity, of following athletic events of national interest in distant cities, play by play, to be granted all of these privileges without leaving one's own fireside constitutes an appeal which even the imperfections and mismanagement attending the establishing of a new industry cannot destroy.

© Western Electric Co.

Mr. Edward L. Nelson.

On the basis of this analysis the fundamental requirement to be met by a broadcasting equipment becomes clearly defined. As the author has pointed out in a recent paper before the Institute of Radio Engineers, it is obvious that the public in listening to the voice of the great artist desires above all a natural and faithful reproduction. The slightest change in tone, any embellishment incidental to the transmission, is a handicap against which the industry must contend. It is possible, even probable, as radio producing technique becomes more highly developed, that systematized distortion may become one of the recognized devices of the studio director. For the present, however, perfect imagery is the goal, and development in the immediate future depends upon how nearly it can be attained.

Of the two principal types of material to be transmitted, speech and music, the former probably presents the more difficult problem. On account of its extremely complicated nature, the transmission of speech with the utmost fidelity and naturalness is an undertaking requiring thorough understanding and a highly developed technique. There is reason to believe, however, that the general transmission requirements for the two classes of material are not essentially different and, in view of the important part which musical entertainment is playing and will probably continue to play in all broadcast programs, it is thought to be advantageous to define these requirements in terms of music.

Experience indicates that for the successful transmission of music, consideration must, in general, be given to frequencies up to 5,000 cycles per second and down to at least 50 cycles per second. The upper limit mentioned (5,000 cycles) lies somewhat above the range of most musical instruments, but it is nevertheless essential that the transmission band of the equipment extend to some such value. Tone quality, that characteristic by which the ear distinguishes between the note of the piano and the banjo, or between that of the violin and the flute, is a matter of overtones in varying amplitude. Naturalness in transmission, therefore, requires that these harmonics be reproduced. Further, it has been shown that the higher harmonics contribute materially to the artistic effect. Musical "brilliance" is apparently merely a matter of their presence in proper proportion.

The lower end of the frequency range is of even greater importance, or perhaps it may more properly be said that it appears to be, since difficulty is usually encountered in obtaining satisfactory transmission for the lower registers. One of the most common criticisms of present day radio equipment, and probably of the phonograph as well, is that it discriminates markedly against the bass. The lower limit that has been mentioned (50 cycles) is of no peculiar significance but happens to be a point upon which attention is focused at the present stage of the art. In certain types of music, in particular, that of the pipe organ, considerably lower frequencies occur. The fundamental of certain of the percussion instruments, notably the bass drums, is also quite low.

The fact that some of the notes of certain instruments lie outside of the frequency band for which the apparatus is designed does not necessarily preclude satisfactory transmission. It is a remarkable circumstance that in certain cases the fundamental and lower overtones may be entirely suppressed without appreciable change in pitch and with very little change in quality.[1] This phenomenon is attributed to the production of subjective tones due to the non-linear characteristic of the ear. To what extent it can be depended upon to facilitate transmission of the lower frequencies is problematical. It would appear to promise little relief in so far as the percussion instruments are concerned since in that case many of the overtones are not true harmonics, a fact which may explain the difficulty usually experienced in reproducing the drums. On the other hand, this action probably accounts for the surprisingly good performance of certain apparatus and renders it difficult to name with complete assurance the lower frequency limit required for satisfactory transmission. It will be interesting to watch the development of practices with respect to this point as the art progresses.

A second important characteristic of musical transmission is the range in volume, which for certain classes of music may represent a power change in a ratio of as great as 100,000 to 1. Orchestral and pipe organ numbers are particularly noteworthy in this respect. Volume is of especial importance from an engineering point of view in that it determines the load conditions under which the equipment will be operated. As broadcasting transmitters are now designed, the factor which determines their useful output range is distortion. The point at which distortion becomes objectionable under increasing load is generally quite clearly defined, being followed by a more or less abrupt change in quality. The phenomenon is usually the result of the peak alternating grid voltage in some one of the amplifier stages exceeding the polarizing voltage in the positive portion of the cycle or, during the negative swing, momentarily interrupting the plate current. In either case, the wave form of the transmission is modified by the peaks being flattened on one or both sides, and to the listener the music appears to break into a jumble of harsh noise. On account of its nature, this effect has come to be known as "overloading."

It is evident that if the volume is to vary in a ratio approaching that mentioned for many musical numbers, the average will have to be set at a relatively low level in order to prevent overloading during *fortissimo* passages. In general, this will result in weaker signals at receiving stations and bring about a decrease in the effective range of the equipment. The practice has grown up, therefore, of manually controlling the volume by adjusting the amount of amplification employed so that while consideration is given to the demands of musical interpretation, the volume is held within considerably narrower limits, perhaps not greater than 1000 to 1. While such practice admittedly precludes a really natural reproduction, experience has indicated that this discrepancy is more than compensated for by the resulting overall improvement in general transmission conditions and, as a matter of fact, the volume variation experienced with most studio music falls very nearly within this narrower range.

This thorough, yet beautifully simple, treatment of the requirements of radio telephone transmission could come from the pen of no one who has not been intimately connected with the evolution of broadcasting equipment. Because we know that everyone who has read this article would like to know more about its author, THE ARMOUR ENGINEER *takes pleasure in presenting a brief sketch of Mr. Nelson's career.*

Edward L. Nelson received his Bachelor of Science degree at Armour Institute of Technology in 1914. For the next three years he was Electrical Inspector with the Pullman Company at Chicago, entering the Engineering Department of the Western Electric Company in New York in 1917. Ten months later he was released to the government as a technical expert in the Naval Department, being stationed in England. Here he worked on radio telephone installations in the war zone, particularly in connection with submarine chasers. During this time he was commissioned a lieutenant in the Naval Reserve Force. In July, 1919, he returned to New York and re-entered the employ of the Western Electric Company, being stationed at Deal Beach experimental station. Here he worked for two years on ship-to-shore radio telephony. Since 1921 Mr. Nelson has been in the laboratories of the Western Electric Company at 463 West Street, New York, where he has been in charge of a group which has developed the present types of broadcasting transmitters.

The second and final installment of Mr. Nelson's article, in which he will describe a type of broadcasting equipment which has found extensive application in radio stations throughout the country, will be published in the May issue.

From another point of view, the volume range is of further importance in that it determines the permissible noise levels in the various apparatus units. At numerous points in the system slight variations in the electromotive forces of batteries or generators, mechanical vibration, induction from adjacent circuits, variable leakage paths, and similar phenomena introduce disturbances which appear as noise accompanying the transmission. It is obvious that if this noise is not to be objectionable it must be kept well in the background. In other words, its level must be low with respect to the minimum value attained by the transmission.

One of the most maligned and least understood objects in the broadcasting world today is the "microphone." In all popular discussion this device is regarded as the prime offender in case of poor transmission, and as the secret of success if satisfactory results are attained. It is a significant fact, however, that before modulation actually occurs, the output of the telephone transmitter or microphone is often passed through as many as seven stages of amplification in which the power is increased several million times. That such a feat is possible at all is a glowing tribute to present day amplifier technique, and this fact should be given due weight when passing judgment on the microphone.

At the present time, the carbon transmitter is more generally employed on account of its considerably better efficiency. No device has yet been produced, however, which is capable of meeting the rigorous transmission requirements with an efficiency at all comparable with that of the type of transmitter now employed for ordinary commercial service. For broadcasting applications, a three stage amplifier is usually provided for use with the carbon transmitter and an additional two stages, making a total of five, for the condenser transmitter. A second advantageous feature of the carbon transmitter is its relatively low impedance which is of the order of 200 ohms. This characteristic makes it possible to separate the instrument from the amplifier by distances of several hundred feet without experiencing serious transmission losses or trouble due to inductive disturbances.

(Continued on page 109)

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[1] A paper by Mr. H. Fletcher, describing this type of phenomenon, is in preparation.

RECENT SUCCESSES OF THE DEPARTMENT OF ARCHITECTURE

By

RUDOLPH J. NEDVED, '21

Of the Department of Architecture

THE progress of the Department of Architecture since 1917 to its present standing is somewhat of a work of marvel—from obscurity to the nation-wide reputation of a department that ranks with the best in the country. This statement is substantiated by achievements of our graduates, not only in offices as designers, practical men, and superintendents, but in competition with the graduates of the biggest and oldest national institutions.

These dreamed of and coveted honors came as a result of the inspiration of the high ideals of our faculty. The search for truth and beauty was not the work of one man but the aim of the whole department. The opportunity came for this unsatiated desire for achievement when our Seniors joined the Beaux-Arts Institute in New York. This meant national competition, co-operation, atelier spirit, and a friendly rivalry that calls for the best effort on the part of the students and the professors.

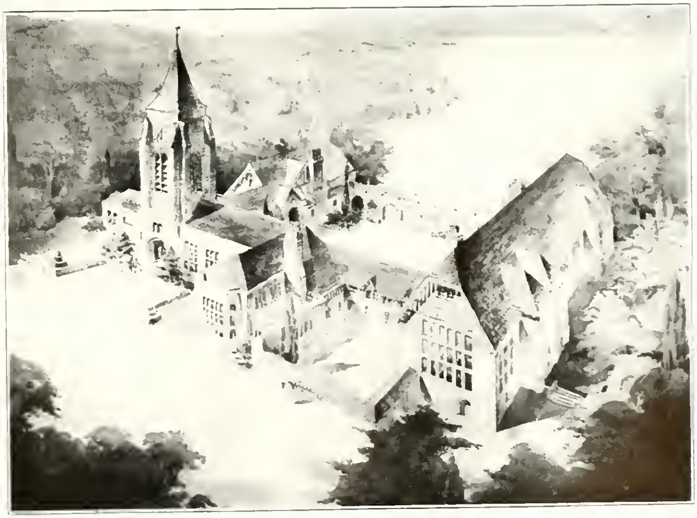
Our first attempt at a national honor came when Leland Cardwell successfully completed the preliminary three-day sketch of a small town plan for the American Academy at Rome Scholarship. He placed second in the finals, losing by a rate to a former "logist."

We entered into "Beaux-Arts" work in the fall of 1920 and were rewarded in the first attempt with a second medal, won by Theodorus M. Hofmeester. Many other medals followed and in the fall of 1921 Rudolph Nedved won the first prize in the Warren Prize Competition. This seemed to give new impetus to the work of the department and a new spirit was initiated, fostered by the strong personality of our good Patron, Edmund S. Campbell. William O'Connor and Joseph Karlson passed the entrance examination of the Ecole des Beaux-Arts in Paris, which is a great honor since there are about six hundred aspirants, from which only forty are chosen. Harry Bieg and I. Jerry Loebl were excused from the First Preliminary of the national Paris Prize Competition, which is open to everyone. In the meantime, Rudolph Nedved won the foreign traveling scholarship of the Chicago Architectural Club, amounting to one thousand dollars. Bieg and Loebl successfully completed the twenty-four-hour esquisse-esquisse of the Second Preliminary—always a plot plan or small town layout—third and first respectively. This placed two Armour men out of five in the finals, in which Bieg placed second, with a first medal, and Loebl third, with a second medal. At about this time, news reached the department that George Conner placed first in the entrance esquisse-esquisse of the Ecole des Beaux-Arts in Paris.

Mr. Otto F. Cerny.

In the fall of 1923, Otto F. Cerny became a candidate for the Le Brun Scholarship. He is a man who must be lauded for his determination. After graduation the fascination of academic work held him and he completed all of the Class "A" problems for a period of two years. During this time he held the position of chief draftsman in the office of S. S. Beman. It seemed that disappointments only made him work harder and at the time of his prize he was also a candidate for the Paris Prize.

The Le Brun Traveling Scholarship was founded by Pierre Le Brun. The New York Chapter of the American Institute of Architects are the trustees of the scholarship. The prize of fourteen hundred dollars is awarded by competition to some deserving and meritorious architect or architectural draftsman, between the ages of twenty-three and thirty, resident in the United States, to aid him in paying the expenses of a European trip lasting not less than six months. The successful competitor must have had at least three years of active practice or three



Perspective of Mr. Cerny's design which won the Le Brun Scholarship.

years' employment as an architectural draftsman. He is recommended and nominated by a member of the Institute. The drawings are to be judged by a jury of at least three architects, who are in no way connected with any school or atelier. The scholarship is meant to supplement school or office experience by travel. It is evident that the competitors have had enough training, both academic and practical, to make a very interesting and highly finished competition. This contest is watched closely by the members of the Society of the American Institute of Architects, who are the most prominent men of the profession.

The scholarship was based on a "practical problem," the program of which read, "A prosperous city of from 100,000 to 150,000 population has voted the funds necessary for the construction of a readjustment centre, for military and civilian neuro-psychiatric cases, to be erected as a war memorial." Although the size of the project was confined to a given plot of ground, considerable latitude was granted in the matter of grouping of the various units of the institution. The building was to contain among other things, a sales room, offices, a small ward, and work rooms to accommodate about one hundred men, who were to be trained in such occupations as woodworking, shoe repairing, bookbinding, and cement and pottery work. Above all things, it was essential that the building be of non-institutional type and cheerful and human in character.

Otto F. Cerny was given the prize because his drawings showed a thorough appreciation of the requirements of the program as written and as inferred. His presentation was uniform and his solution logical, straightforward, and picturesque. The jury gave proper consideration to the records of qualification filed by the competitor as well as to the comparative excellence of the drawings submitted. In working up this problem a great atelier spirit was shown and many contributed to its success. The candidate, however, was the master of ceremonies, as it was he who was responsible for the final expression of the problem. Cerny sailed for England on the twenty-first of May and since then has covered Belgium, France, Czecho-Slovakia, Austria, Italy, Morocco, and Spain.

The time was now ripe for our greatest honor, the Paris Prize.

Harry Kurt Bieg is a Chicago product—a graduate of Lane Tech High School. He came to Armour Tech where he showed unusual ability and a wonderful choice of selection in design. He became acquainted with the Burnham Library early in his course and knew many solutions of existing buildings or "Beaux-Arts" problems for every problem. Bieg took his studies very seriously, his amazing grit and perseverance winning admiration from his friends. He was always loyal to his friends and very dependable. Between his Junior and Senior years he spent five months in Germany, France, and Italy. He came back to his Senior year, fired with the spirit of the Old World, and his remarkable record doing Beaux-Arts Design problems gave him sufficient points to rank among the fifteen who were excused from the First Preliminary of the Paris Prize with four or five medals to his credit. His first failure in the Paris Prize Competition only made him more determined than ever and in his second trial he won with ease.

Harry Kurt Bieg, winner of the seventeenth Paris Prize Competition.

The Paris Prize of the Society of Beaux-Arts Architects is a national competition for the purpose of choosing a scholar to pursue his studies as a guest of the French Government in the First Class of the Ecole des Beaux-Arts of Paris for two and one-half years. The society provides three thousand dollars (which is donated by members of the society and friends) for living and traveling expenses during the period. The Paris Prize Competition is open to all citizens of the United States under twenty-seven years of age. It is considered the most important award in architecture in the country.

The First Preliminary is a twelve consecutive hour rendered sketch, under supervision, of a small building or of some decorative interior. Five competitors are selected from these hundreds of sketches by a jury, to enter the Second Preliminary Competition, along with those exempted from the First Preliminary owing to their previous qualification in the finals of the Paris Prize or high standing in the B. A. I. D. competition, Class "A."

The Second Preliminary consists of a twenty-four consecutive hour sketch, under supervision, of a small town or large building plan, showing the competitor's knowledge of the theory of planning.

Five competitors are chosen from these twenty to twenty-four to enter the Final Competition. These five men are required to make "esquisses," under supervision, for a problem in advanced design in thirty consecutive hours, indicating the preliminary solution of the problem which is to be developed in the next ten weeks. If the preliminary scheme is abandonded, the finalist is given an *hors concours* (out of competition).

The final drawings are made by the individual in New York, but before this he is allowed outside help and criticism. This is where all the fraternal and loyal spirit of the school comes forth. In New York and other eastern cities, the ateliers have big conclaves and students pledge their help to the finalist with a resolution that he will be sent to Paris. The scheme is studied and restudied, turned backward and forward, and all other possible schemes are studied and weighed. As the time is shortening, the best, simplest, and most orderly solution is growing and giving place to doubt and chaos. One actually sees the building in its beauty and solidity. All bend their efforts to clear little difficulties and to put the drawings in shape to send the competitor to New York. Here he is assigned a loge, where he is left alone to transfer the drawings to the final paper and present the problem to the best advantage. Then the great suspense of the judgment—possibly failure, perhaps success.

The program for the seventeenth Paris Prize Competition was

A Transportation Institute

"A capitalist who has amassed a large fortune in the manufacture of machinery used in transportation has always had more than a monetary interest in the subject. He believes that quick transport is a civilizing influence and also that it is possible that important advances made in the means of intercommunication between the peoples of the world may lessen the likelihood of great conflicts. He has seen the immense advance made in certain branches of science during the late war, which was due to the disinterested co-operation of scientists.

"With all this in mind he wishes to assemble a representative group of inventors and scientists including chemists, physicists, engineers, electrical

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THE ARMOUR ALUMNUS

PROF. J. C. PEEBLES, *Editor*

The annual mid-winter banquet of the Alumni Association was held on January 21, at the Auditorium Hotel, Chicago. About 250 graduates and former students were present, which is the largest mid-winter meeting that we have ever had. The class of 1904 made the best showing, with an attendance of seventeen out of a graduating class of thirty-two. After twenty-two years this class showed an attendance of better than 50 per cent, a record for other classes to shoot at.

Our alumni trustee, Mr. R. M. Henderson, was present. This was the first opportunity that many of the members had had to see him since his election to the board, and all were very much interested in hearing him speak. He had nothing of importance to report in his capacity as trustee, no recent meetings of the board having been held. Mr. Henderson is very optimistic about the future of Armour Tech, and alumni may rest assured that they are well represented on the board of trustees.

The principal address of the evening was by President Raymond. He told the boys something about the work that is going on at the Institute—of the activities of professors and students. Many of the members of the faculty, he said, are devoting themselves to certain specialized lines of study and work, and are becoming recognized as experts in their special fields. All this, Dr. Raymond thinks, makes the professor a better teacher, and at the same time gives A. I. T. an opportunity to be of service to engineering and industry in this community.

Mr. O. A. Rochlitz, president of the association, asked that each class elect a secretary to work with the general secretary in endeavoring to build up the membership of the association. All men who have been students in good standing for one year are eligible to full membership, and many such former students can be brought in with a little work. It is hoped that the class secretary, co-operating with the members of his own class, will be able to accomplish much in building up our association.

One of our recent graduates, **Mr. E. O. Pierce, '24**, is with the Ohio Inspection Bureau, with headquarters at Columbus. This is practically in the center of a great industrial region, which is probably destined to become one of the greatest manufacturing districts in the world. We are pleased to present below a brief article by Mr. Pierce on the Ohio Power Company and its system of superpower, the development of which is just getting under way.

THE OHIO POWER COMPANY'S SUPERPOWER SYSTEM

By E. O. Pierce, '24

Superpower seems to have come to stay. Of the various projects involving the linking of generating stations into chains of superpower lines, one of the largest is that of the Ohio Power Company, a subsidiary of the American Gas and Electric Company.

This system serves one of the largest industrial centers in the country, namely, northern Ohio. Coal mines, steel mills, potteries, glass factories, brick plants, foundries, rubber plants—such basic industries are, and will be, served by this new power project.

But neither the new plant which we are to describe, nor the system of which it is a unit, is phenomenal. The plant is a large one, efficient, up-to-date, and carefully designed. The system is one of several superpower systems in operation today. The significance of the new plant is that it is one of the initial steps in a great industrial expansion involving the *entire Great Lakes section of the Middle West.* A Great Lakes—Ocean waterway is coming—is sure to come. And with it will come an industrial expansion of this territory so phenomenal in extent as to have never been equalled Nor is the Ohio Power Company the only large concern to forsee and prepare for this event. The Ohio Bell Telephone Company, another leader in the field of public service, has forseen it through the medium of its Plans Department, and is arranging to meet the demands it will impose. No doubt still others anticipate this event and are preparing accordingly.

Philo Station is one of three similar plants in construction or being planned. Others are to be located at South Bend and Fort Wayne, Indiana. When completed the superpower line is to reach through to Chicago from Windsor, W. Va.

The Philo plant is located on the Muskingum River, about 60 miles east of Columbus, Ohio, near Zanesville. It is of the sectional type, which will embody, when all units are installed, an ultimate capacity of 210,000 kv-a. Its present capacity is 70,000 kv-a. in two 35,000-kv-a. steam turbo-generator units. Current is generated at 11,000 volts and is transmitted at 132,000 volts, although plans provide for transmission voltage of 220,000 with the completion of the plant. Three Westinghouse and three G. E. 15,000-kv-a. single phase, oil and water cooled transformers raise the potential from 11,000 to 132,000 volts. General Electric 135,000-volt, oxide film lightning arresters, and 135,000-volt, 300-ampere circuit breakers protect overhead equipment. About 9 per cent of the present capacity will be used in the station auxiliary equipment. The full capacity of the station will be utilized at least until four units are placed in service.

Under conditions of maximum capacity this plant will consume about 1500 tons of coal daily, obtainable within a radius of 10 or 15 miles. At present a large proportion of the coal used is transported down the river on barges, from points within 10 miles of the plant. Current is in turn used in the mines from which the coal is obtained. A singular feature is the ample provision for coal storage. Wet storage capacity is 300,000 tons, and dry storage capacity, 100,000 tons, which means that the plant could run at maximum capacity for 9 months with coal from storage.

Crushed coal is used (with present equipment) in six 1400-hp. B. & W.

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"US ENGINEERS DON'T NEED NO ENGLISH"

During an open hour a number of Sophomores are gathered in Chapin Hall drafting room, making more or less successful efforts to solve some problems in the next day's calculus lesson. So far as unit output, that is, problems solved per student, is concerned, a "math bee" like this is usually productive of better results than when the work is done individually. Everybody has all the easy problems, but nobody has the hard ones. These are solved only by the solitary thinker, undisturbed by the rabble. From a "bee" like this the gang gets more honey than it deserves, while the thinker very likely gets stung.

Suddenly one student, having collected his unearned increment of honey, slams his book shut and rises from his chair with an air of finality. "I certainly hate these kind of problems, and I ain't going to waste any more of my time on them."

In addition to an erroneous estimate as to the value of his time, this young man is guilty of two assaults on the mother tongue. One is an inexcusable solecism often used by those who should know better; the other, a plain vulgarism never heard among cultivated people. Speech like this is the despair of the teacher of English. The lad may know every rule in the grammar, and can correct his errors when they are called to his attention, but still he continues to make them. It is the result of slovenly mental habits usually formed very early in life from bad example at home or elsewhere. Against such a heritage school and college struggle in vain.

In the recitation class in physics sits a young fellow who is finding the course in engineering a bit too much for him. He has been struggling desperately to retain his footing amidst a flood of physics, mechanics and mathematics, but he is being carried slowly beyond his depth. He has tried to solve problems involving zero and infinity, but he feels that he cannot master all that lies between—certainly not in a single semester. When the professor suddenly shoots at him the question, "What is a vacuum?" he dives like a frightened teal into the flood of facts about him and comes up with this: "A vacuum is where nothing fills all space."

Here is a lad who knows practically nothing about what he is asked to define, and of course his answer is meaningless. If one would speak or write clearly and convincingly on any subject he must first make himself complete master of that subject. The change from a mental to a spoken picture is seldom accomplished with an efficiency of one hundred per cent; there is nearly always a loss in the transition. If the mental picture is not clear and distinct the spoken or written likeness is very likely to be nothing but a blur. Sometimes, of course, a very clever speaker who has only a superficial knowledge of his subject can trace, in beautiful words and phrases, a feathery arabesque which is highly entertaining to his hearers. They admire his artistry but they carry away with them no enduring memory of what he said. For most of us precise knowledge is the great prerequisite without which clear written expression is impossible.

The class in valve-gears has just finished a written lesson in which this question appeared: "Describe the construction of an eccentric on a steam engine and explain its function." Later, as the professor is reading the papers, he finds this answer to the question. "An eccentric is a thing on the shaft of the engine to move the valve with. It is held on with a strip of metal in a slot, or with a bolt, and it slips around as the engine turns. If it slips too far the engine stops or runs away, as the case may be."

The professor is in a tolerant frame of mind, and he recognizes the germ of an idea in what the student has written. He reads the answer several times, but finally more in sorrow than in anger, he applies the blue pencil, thinking as he does so: "Such an eccentric never was on land or sea." Stripped of its poetic expression and reduced to the language of the engineer, the professor's comment simply means, of course, that such a device was never used in stationary or marine practice.

In addition to very meager information on his subject, this student lacks the mechanics of adequate expression, the words and phrases in which to clothe his ideas. An eccentric might have been called a device, a piece of mechanism, a part of the valve gear, but "thing" is not very expressive. He has not learned that a strip of metal in a slot is a key, and instead of bolt he means set-screw. His ideas as to how the eccentric slips are entirely chaotic and the whole dictionary would not help him here.

An inadequate equipment of words is a common, but not serious, cause of poor speaking or writing. It is not serious because it can be overcome, and usually is if one is observant in reading and in conversation. Seeing and hearing words used correctly can hardly fail to increase the vocabulary, except in the case of those hopelessly unobservant and lazy.

Several students are just about to leave the main building, their minds intent on lunch at the fraternity house. One of their number, however, declines to go with them, and turns towards the Library. "No lunch for me today, fellows; I must finish these notes and get them in to the professor of cold storage by one o'clock, or I'll flunk the course." So he goes to the Library and writes frantically during the noon hour.

When the professor reads these notes prepared by the lad with the high-speed pen, his eye falls upon this sentence: "Cold storage has made it possible to freeze meat and is responsible for the high price of eggs."

In the course of his lectures the professor had stated that mechanical refrigeration and cold storage had made possible the frozen meat industry, as a result of which almost the entire world had become a possible market for fresh meats prepared in America. Later, in discussing some of the economic results of refrigeration and cold storage, he pointed out that it had greatly reduced the seasonal price fluctuations in many commodities, notably eggs, by providing a market in times of large production, and a source of supply when production is low. Out of these two unrelated observations of the lecturer, the student had evolved one rather remarkable sentence.

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THE ARMOUR ALUMNUS

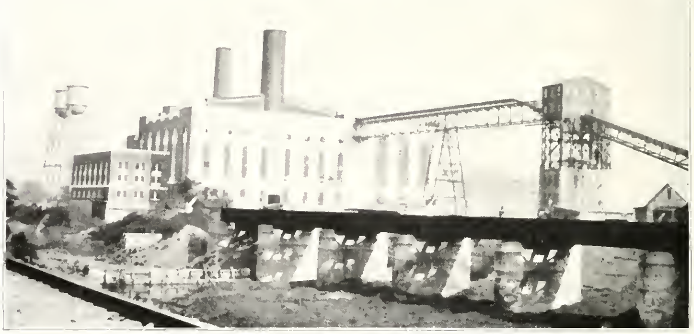
(Continued from page 97)

water tube boilers, and two 500-hp. re-heat boilers, all equipped with Cox chain grate stokers. Condenser and boiler feed-water is obtained from the Muskingum River. Part of the water is distilled and stored in a large gravity tank. Another part is treated and stored in another gravity tank. Also, water from the condensers returns to the boilers. Chemists maintain constant observation over the feed-water as well as over all other supplies and materials used in the plant.

Provision is made for an exchange of heat between the air of the generator cooling system and the boiler feed-water. Air from the generators passes through this boiler feed-water, heating it from 80 to 140 degrees F. The air circulating system for cooling the generators is entirely enclosed, eliminating the necessity for scrubbers.

Two 35,000-kv-a., 1000-r.m.p. G. E. turbo-alternators operate on a steam pressure of 650 pounds per square inch. Efficiency runs have started only recently and the resulting data are not yet available.

With all the provisions made for expansion, before many years Philo Station will be too small to meet demands placed upon it. Other stations will have to be erected in the vicinity, and Philo will become one of several. Its connections with the beginnings of a great industrial expansion, although obvious, will never be generally known. The significance of Philo Station will be forgotten. Such is the glory of engineering achievement!



Philo Station of the Ohio Power Company, located on the Muskingum River, near Zanesville.

CIRCUS DAY

The undergraduates are making elaborate plans for Circus Day, Saturday, May 9. They are particularly anxious to have the alumni turn out in force, and that is the main reason for holding the event on Saturday. The committee in charge extends a special and urgent invitation to all graduates and former students to attend. We present herewith their invitation:

Alumni, we are planning to hold a reunion at Armour which bids fair to set a precedent and form the foundation for an annual "get-together." We have always welcomed you on Circus Day, but this year you will not want to stay away. In past years the event was held the last Friday of "Junior Week," but this year, to enable you all to attend, Saturday, May 9, has been chosen as the day. The festivities will begin at one o'clock.

Do you remember how, when you were in college, you enjoyed the Soph-Frosh rush, the Senior-Junior tug of war, the fraternity stunts, the track meets, and best of all the reunion of all the old grads? This year, we will have all of this in store for you and many other attractions.

There will be open house at all fraternity houses and many have arranged to hold their annual alumni events on this day.

The annual Junior Prom will be held Friday, May 8. The time, the place, and the music will be announced later, but you can rest assured we are leaving no stone unturned to make it a dance long to be remembered.

Julius V. Steindler, '13, was a caller at the Institute recently. His course was Architecture, and since his graduation he has practiced the profession in Vienna, Austria. He has recently, however, given up architecture and turned to mechanical engineering in the automotive field. He is manager for a firm in Vienna, making a rather extensive line of automobile accessories. He is at present making a tour of the United States, studying American production methods in manufacturing. Mr. Steindler states that while materials cost just about as much in Austria as here, and labor is cheaper, yet it costs about twice as much to build an automobile there as it does here. Quantity production is the reason for our advantage, and Mr. Steindler proposes to import American methods into Austrian industry.

Ronald B. Clark, '12, is another interesting alumnus who visited us recently. He is European representative for the Allied Machinery Company of New York, handling a line of American-made machine tools. Mr. Clark makes his headquarters in Paris, but his business extends over France, Belgium, Holland, Spain, Italy, and Great Britain.

Perhaps many of us fail to appreciate the extent of the American machine tool business in Europe. Mr. Clark states that in the continental countries where he does business, from 70 to 80 per cent of all machine tools used in the factories are of American make, while in England the proportion is about one-half. Many of the finest French and Italian motor

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EDITORIALS

On December 23, 1924, Professor Freud, of the Department of Chemistry, married Dr. Henrietta Zollman. The bride has received the degree of Doctor of Philosophy in Chemistry from the University of Chicago.

Our Lincoln assembly on February 11 was addressed by Dr. Charles A. Richmond, president of Union College, Schenectady, New York. His talk was based upon the two outstanding elements of Lincoln's greatness—his love of human freedom and his passion for human brotherhood. Dr. Richmond was introduced by our own Professor Phillips, a graduate of Union.

The assembly of February 17 brought our old friend, Dr. Shannon, with a new message. He told us of the joy which may be found in some of the non-taxable assets of life. Dr. Shannon's annual visit gives the short month of February an enviable place in the calendar of the Institute.

Dean Monin represented Armour Institute of Technology at the inauguration of Dr. Mark Embury Penney as president of James Millikin University at Decatur on February 17.

The friendly smile of Miss Curtis has been missing from the Library since the first of the year. The new Assistant to the Librarian is Mrs. Anna J. Edman, who comes to Armour Tech from Valparaiso University.

The sixth edition of "Steam Power Plant Engineering," by Mr. George F. Gebhardt, Professor of Mechanical Engineering, has just come from the press of John Wiley & Sons, Inc. Professor Gebhardt has labored unceasingly in the revision of the book that it might be brought into accord with more recent practice. "Steam Power Plant Engineering" is a standard text in the technical and scientific colleges of this country from Maine to California. Its present up-to-date form has increased its utility as a reference book for power plant engineers.

Did you ever notice how our president announces a half holiday after an assembly? He knows we know what's coming and we know he knows we know it, so he draws out the speech of announcement longer and longer. His eyes twinkle and you can just see he is laughing inside of him. And just as we are all about to burst he casually announces classes will not be resumed until tomorrow!

STEPHEN JOHN LIBBY

The sympathy of the entire college is extended to Professor Libby in the loss of his youngest son. Stephen John Libby, age fifteen, died Saturday afternoon, February 14. His death was caused by the accidental discharge of a rifle with which he had been playing. The bullet entered his forehead and shattered his brain. The funeral was held the following Tuesday.

Stephen Libby was in his first year at Tilden High School. He was a member of the R. O. T. C. and of the Boy Scouts. He ranked high in the honors he had won as a Scout.

THE AERONAUTICAL ENGINEER

The place of the aeronautical engineer in America at the present time is peculiar, first, in the fact that it is difficult for him to get the necessary training, and second, in the fact that having had such training it is difficult for him to find remunerative employment. Influences are now at work which will no doubt bring about an early change in these conditions.

The aeronautical laboratories of the world are constantly investigating and learning new facts about the problems of flight. Much of this information is quickly published and becomes available for engineers. In our own country our laboratories, both private and Government, are doing their full part in this important work. Guided partly by the results of these investigations and partly by the performance of existing machines, many airplanes having features that may be classified as experimental are being built and flown. Some types are now becoming standardized, but not to the extent existing in other engineering structures. Motors are being reduced in weight per horsepower. More powerful units are being built when needed, and small motors are being made better. All of them are being made more reliable. Structurally, airplanes are being improved, and there is now a tendency toward metal construction. Altogether, improvement and refinement are rapid and important.

The result of this continued effort and study is that the principles of design are now pretty well understood. Within our present limits of speed, load, climb, ceiling, and endurance, the engineer has sufficient data to enable him to produce a machine for a given performance with a surprising degree of accuracy.

More people are learning to be airplane pilots, and an increasing number of people are overcoming their timidity about flying as passengers, on account of the demonstrated reliability of the ships. Reports of successful and reliable passenger and express carrying by air in Europe increases interest in this country.

The success of the world flight stimulates the pride of the public in the army and navy pilots and engineers. It is understood that these pilots must take chances that are not necessary in private flying. There is rather convincing evidence that public sentiment favors an adequate air force as a matter of national insurance.

Lighter-than-air ships are still experimental, but in all probability they will

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SOCIETIES

ENROLL NOW!

A thoughtful English student from the London School of Economics made this remark: "In England you go to the university to develop yourself, while in America you go to the university to distinguish yourself. In America a boy is always endeavoring to attain some outward sign of achievement, to make the college paper, to make one of the clubs or fraternities, to make the football team. The center of gravity is in the world of action far more than in the world of thought."

Could it be that this thoughtful student missed the vital fact? In the pursuit of college activities the student develops his *self*. The development of *self* is one of the major tasks of education. The big *university* for the development of self is a university composed of engineering societies, football teams, orchestras, bands, glee clubs, and college papers.

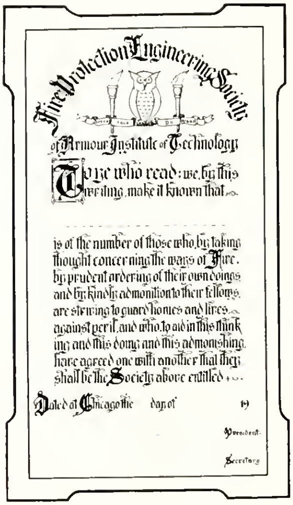
In the small college the balance is undoubtedly in the favor of the student. His opportunities to enter the *University of Self Development* are overwhelmingly greater than in the larger institution. Armour is a small college. A word to the wise is sufficient.

Another association has been added to the family of organizations at Armour. The Press Club was established for the purpose of training and selecting men for positions on the staffs of the college publications. In the past, the selection of staff members has been a more or less hit-or-miss proposition and the training of the men chosen has frequently been insufficient. Under such circumstances, there is a loss of efficiency and a waste of effort. The Press Club appears to be the solution of the difficulty. Press Club members will be educated in the business of editing and managing the Armour Tech publications. The ability and the eagerness shown will measure the qualifications of a man for a staff position. The new organization promises to be of the greatest aid to any student who is possessed of editorial or managerial ambitions.

It is required that the members of the Press Club have completed one semester at the Institute. Written application must be made to the membership of the club. Twenty-one applicants were accepted at the first meeting.

Due to the grave illness of Professor Finnegan, his absence has been keenly felt at the meetings of the Fire Protection Engineering Society. In an attempt to fill the vacancy, Professor Nelson has arranged to have the following speakers address the meetings: R. E. Vernor, Manager the Fire Prevention Department, Western Actuarial Bureau; Harry Rogers, Engineer, Fire Prevention Department, Western Actuarial Bureau; Wellington R. Townley; Frank H. Jones, Publisher, Illinois Inspection Bureau; Benjamin Richards, Manager, Underwriters' Service Bureau; and Robert J. Folonie, Attorney, with Bates, Hicks and Folonie.

At the next annual meeting, the artistic shingles, designed and made by Mr. Townley, will be presented to the Freshman members. In the matter of having a shingle for their organization, we believe we are safe in saying that the Fire Protects are unique.


Fire Protection Engineering Society
of Armour Institute of Technology

To ye who read: we, by this writing, make it known that

is of the number of those who, by taking thought concerning the ways of Fire, by prudent ordering of their own doings and by kindly admonition to their fellows, are striving to guard homes and lives against peril, and who, to aid in this thinking and this doing and this admonishing, have agreed one with another that they shall be the Society above entitled.

Dated at Chicago the day of 19

President.

Secretary

The first shingle at A. I. T.

The idealistic person is the brain of organization. Chemists are distinguished by their passion for C. P. stuff. In an effort to counteract this tendency the American Institute of Chemical Engineers has had a splendid group of speakers who have delivered real facts on concrete matters.

On December 18, Dr. David Klein, Vice-President of the Wilson Laboratories, gave a lecture on Glandular Therapy, describing the recent work done in the utilization of gland secretions in the packing industry. Professor Freud of the Chemical Engineering Department put the Chemicals wise to the Fundamental Precepts of the Chemical Engineering Profession, in a lecture given January 29. A paper, valuable because of its impartiality, was read by Mr. J. C. Ingram on the Selection and Operation of Filtration Equipment. Mr. Ingram is affiliated with the Celite Products Company.

The technical organizations have welcomed a new member into their fold. The Armour branch of the American Society of Civil Engineers is the result of earnest agitation started last September. The group was recognized at a meeting of the Board of Directors of the Society in New York, January 16, 1925 and the Armour branch was chartered January 29. Its membership is limited to members of the Junior and Senior classes in Civil Engineering. The parent organization, the Western Society of Engineers enjoyed an illustrated lecture on The Romance of Clay and That Matter of Health, presented by Mr. W. D. Gerber, February 5. The Western Society of Engineers and the American Society of Civil Engineers are planning a joint smoker.

The writer made a visit to the Armour Radio Station recently and found out a lot of things he didn't know before. At present the station is operating one 250-watt tube with a plate supply of 1500 volts, supplied from a motor-generator set located in the vault in the northeast corner of the first floor of the Physics Laboratory. The wave length most generally used is 80 meters, but recently the station has been using 40 meters for some experimental work with splendid results. A transmitter is now in the process of construction for work on a wave length of 20 meters.

The receiving set is of the standard three-circuit low loss regenerative type, covering a wave band of from 35 to 90 meters. A three-step amplifier boosts the signal strength up to where a loud speaker can be used.

The station has an operating staff of twelve licensed operators with L. M. Endres as their chief. The station is on the air all night on every night except Saturdays and Sundays. Their signals have been heard in all parts of the United States and Canada, and in New Zealand. Visitors are always welcome and the operators are ready to relay messages to any part of the world for anyone. Since the station was first put into operation last fall, over two hundred citizen radiograms have been handled. The station is located at the north end of the second floor of Chapin Hall, first entrance.

The engineering societies grouped together for a joint meeting January 15. Mr. Albert Brunker, Chairman of the Board of Directors of the Liquid Carbonic Company addressed the organizations on The Relation Existing Between Business Practice and a Technical Education. The meeting was sponsored by the American Institute of Chemical Engineers, and has been pronounced a decided success.

All the while the technical societies have been functioning, the musical clubs have been far from idle. Professor Phalen has managed to have the musical organizations provided with plenty of concerts in and out of the college. The Orchestra and Glee Club were broadcast from the Central Y. M. C. A. January 28. The Glee Club expects to appear at the Chicago Theater in the near future.

The A. I. E. E. men have gone in for commercial survey work. Mr. E. Thurston, who is Commercial Engineer of the Illinois Bell Telephone Company, gave the first lecture. Mr. Thurston defined a commercial survey as an estimate of the number of subscribers the company would have to provide for in the future.

Rumor has it that the Junior Electrical class is going to put on an A. I. E. E. smoker that will shame any 90 per cent bill ever shown at the Palace. It is said to be a farewell party for the Seniors.

ENGINEERING NEWS

The Total Solar Eclipse of January 24, 1925

Prepared for THE ARMOUR ENGINEER by Professor J. A. Parkhurst, of Yerkes Observatory

Everything relating to the sun is important to dwellers on the earth since they depend on the solar activity for all of the life they enjoy. Solar studies are therefore being pressed at many laboratories, and their results are growing in interest from year to year. But the corona, the sun's outer atmosphere, can be observed only when the dazzling light of the disk is hidden. Its brightness is comparable to moonlight, while the sun's direct light is many thousand times as bright. It is only when the moon comes directly in line with the sun and eclipses the light of the disk that the glare is cut off and the corona becomes visible. Many attempts have been made to devise some scheme to cut off the direct light and observe the corona without eclipse, but so far all have been unsuccessful. One of the most famous attempts was made by a man in Kansas (I will not mention his name), who thought he had succeeded when he took the precaution to "flood the tube of the telescope with absolute darkness." If he had done so he would certainly have deserved success.

While it is still too early to give definite reports, it is safe to predict that important results will come from the observations of this eclipse, since such a large variety of instruments were pointed at the sun under fairly good conditions of seeing. Ordinary cameras, from pocket kodaks to special forms with foci as long as sixty feet, yielding direct photographs of the corona, will serve to compare its form and dimensions with those of previous eclipses. The corona has special forms depending on proximity to sunspot maximum or minimum, which recur in periods of about eleven years. The present eclipse was just after a minimum, and the photographs which I have seen agree with the usual type. Many instruments were used to determine the amount and spectral distribution of the coronal light. Among them are the photo-electric cell, the thermo-couple, and the direct-vision photometer, which latter I used at Cornell University, Ithaca, New York. This instrument is shown in Figure 1.

It is of the form known as the Hartmann microphotometer. Briefly described, it consists of two tubes, one of them, *T*, pointing at the corona, and the other, *T'*, pointing at an incandescent lamp, *L*, of known candlepower. By suitable reflections the light from these two sources is united in the ocular, *O*, as two adjacent illuminated areas. The light from the lamp passes through a wedge, making it possible to cut it down by a known amount until it equals the light from the corona, thus furnishing a quantitative measure of the light of the latter. This same instrument was ready for use at the eclipse of June 8, 1918, at Green River, Wyoming, and the eclipse of September 10 at Catalina Island, but clouds prevented observations at both places. It was a great satisfaction, therefore, to have a clear sky at Ithaca, and be able to carry the measures through as planned. This was done in the ordinary visual light, in the green and in the blue; thus giving data on the spectral distribution as well as the amount of the light.

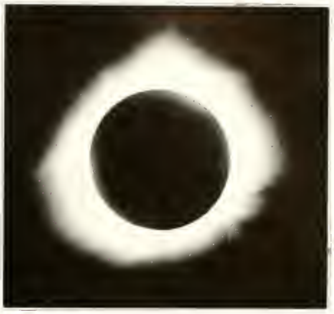


Figure 2. The solar corona. "One of the most beautiful and impressive of all natural phenomena."

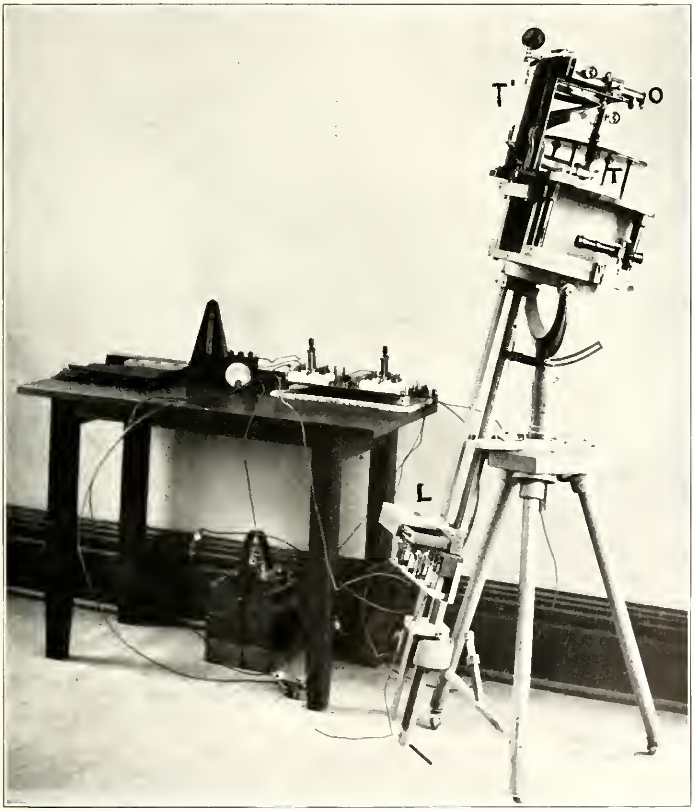


Figure 1. The Hartmann microphotometer, used in measuring the amount of the coronal light.

By the kindness of Mr. Edson Pettit of the Mt. Wilson Observatory I am able to show a direct photograph of the corona taken with a telescope of six inches aperture and fifteen feet focal length. (See Figure 2.) This was made at the Van Vleck Observatory at Middletown, Connecticut and had an exposure of fifteen seconds. This was part of a photometric program which included measures with a thermo-couple, and will give the distribution of energy in the visual rays and in the infra-red.

Many observations were made to determine the exact limits of the moon's shadow, which will yield corrections to its orbit. Reports from New York City indicate that these limits were fixed within the length of a city block. Professor E. W. Brown of Yale University, who is the foremost authority on the orbit of the moon, was very active in directing these observations, and had the hearty co-operation of the *Scientific American* in the campaign.

Coming down to the effects of the eclipse on the earth and its atmosphere, observations were made of temperature and magnetic changes such as have been followed for many past eclipses; but for the first time careful watch was kept on the effect of the moon's shadow on the transmission of radio signals. The first reports indicate that no effect on the transmission was found, but later reports may modify this conclusion.

On the whole, science is to be congratulated on the success attending this eclipse, and the East may well be proud of the character of the weather furnished, after the West had failed us in the last two chances.

The Grant Park Stadium

Prepared for THE ARMOUR ENGINEER by Mr. F. E. Brown, Structural Engineer for Holabird & Roche

The general features of the Grant Park stadium with regard to layout, design and purpose were described in the November issue of THE ARMOUR ENGINEER. This article supplements that with a brief description of the structural features.

The Grant Park stadium is located on filled-in land at a point where, until a few years ago, the original ground or lake bottom was covered by fifteen feet of water. Below this the soil was soft through a depth of fifteen or twenty feet. For this reason special consideration of the type of foundation to be used was necessary.

The fill was not suitable for bearing. Test borings in the vicinity indicated that rock was from 80 to 90 feet below city datum. The loads came at points that required individual foundations, and were too light to justify the use of piers to bed rock. Also, the material in the upper 30 to 40 feet was such that wells would be difficult to sink.

Pile foundations were selected as best filling the requirements. Test piles which were driven indicated that piles capable of supporting the loads were required to reach a stratum 60 to 70 feet below the level of the lake. As this length eliminated the possibility of the use of concrete piles, wood piles were used. The elevation of the structure was such that the tops of foundations were very little above datum, which also made it practicable to use wood piles with a cut-off below water level. The piles used were 60 to 65 feet long, 14 inches in diameter at the butt, and 7 inches in diameter at the point, and were grouped in accordance with the loads. In general, the loads came on columns for which individual foundations were provided. Piles were designed for 30,000 pounds each, based on the test driving and general conditions at the site.

The program of the Chicago Plan Commission required that materials be used in the construction that are fire and weather resisting. Concrete was selected as best meeting these requirements, and the bulk of the structure, therefore, is of concrete. This was poured in place, reinforced as required for the loads, troweled, tooled, and dressed for decorative purposes. Some of the more decorative sections are of special precast concrete or artificial stone.

There were no loads or spans that were particularly difficult to provide for with reinforced concrete. In general, the construction is the beam, girder, and slab type. For the seats, tier construction was used, with inclined girders between columns. Joists between girders served as risers while slabs between joists served as treads. The girders, because of the tier construction, had to be designed in most cases as rectangular beams. The joists were designed as tee beams with one flange, and vary in depth from 11 inches to 15⅛ inches, with a minimum width of 6 inches to accommodate two reinforcing rods, and a maximum width of 8 inches to provide the necessary shear area in some parts where the joists are shallow.

Several structures similar to the stadium have shown deterioration with two primary causes established. These are poor concrete and change in volume due to temperature and moisture. Where good concrete was used with proper provision for change in volume, little evidence of deterioration was found. Several structures, however, showed considerable evidence of injury from expansion and contraction. The provision for enough and proper expansion joints was therefore considered important. These joints were made at approximately 50-foot intervals in each direction. The joists are designed as continuous between expansion joints, and vary in span from 10 feet 2 inches to 20 feet 3 inches, the latter being the typical span. Each section of the stadium between expansion joints consists of two or three bays with cantilever arms at one or both ends.

The slabs or treads of the tiers were made three inches thick, reinforced with wire mesh bent to conform to the tier construction, and continued through both treads and risers. In the aisles two steps were used to each tier. These steps were cut into the risers where necessary. Where this occurred on the cantilever arms, the form work and reinforcement necessarily became somewhat complicated. The columns were all reinforced concrete with a minimum section 16 inches square. These were braced by horizontal concrete struts where necessary so as to reduce the number of long, unbraced columns. Some of the columns, namely, those in the Exhibition Hall, were made larger than necessary as a part of the architectural treatment. The concrete girders over the Exhibition Hall have a span of approximately 50 feet, and in certain portions carry a part of the weight of the colonnade. These girders were designed as rectangular beams of single span. In order to save weight and concrete, the tops of these girders are curved. The large columns of the pavilions are hollow, having a minimum wall thickness of 5 inches. They were precast in sections about 5 feet high, and were reinforced with wire mesh and vertical rods.

Joists and girders were designed with the usual moment factors for continuous beams, 1/10 for the positive moment of end spans, and 1/12 for intermediate spans. In some cases special moment factors were arrived at by the use of the theorem of three moments. This is particularly true where cantilever ends occur. Also, for slabs less than 4½ inches thick, moments factors were varied from the usual theory, a factor of 1/9 being used on the average. Rods were continued over the supports to provide for negative moments, alternate rods being bent and continued to the quarter point of the adjacent span. The stresses allowed were those prescribed by the Chicago Building Ordinances. The imposed live loads were 100 pounds per square foot as a general case, with 150 pounds per square foot for stairs, aisles, ramps, and bridges. Special loadings were used for rooms containing mechanical equipment, such as the boiler room, coal bins, etc.

The wood seats on all tiers were made of 2-inch by 12-inch fir planks, supported on creosoted oak blocks of sizes to bring the seats to constant height. The blocks were fastened to the concrete with heavy expansion bolts.

Drainage of the tiers was accomplished by pitching the slabs forming the treads, and the installation of gutters at certain points. The main roof of the pavilion has asphalt roofing over the concrete, and, for that portion that is visible, ornamental clay tile. On the promenades of the upper deck, tiles were laid on waterproof cement. In all other places concrete is used to shed water. All exposed surfaces of concrete in the pavilion were made of special aggregate, and tooled to simulate cut stone. The exterior wall facing is of precast concrete, a special aggregate being used, tooled, and set in place as natural stone.

The South Water Street Improvement

By George D. Arachovitis

The South Water Street improvement was begun in October, 1924, with the wrecking of the block between Franklin and Lake Streets. When, in June, 1924, the city council voted the necessary appropriation for preparation of the final plans, the Bureau of Design of the city of Chicago had a personnel of some fifteen men. Since then the office force has been increased to about one hundred engineers, designers, and draftsmen. This gives some idea of the amount of work involved in the planning and designing of the improvement.

The design, with a few modifications follows much the same plan as that presented to the city council at the time of passing the ordinance. The improvement consists of the construction of a two-level thoroughfare in the following locations: East South Water Street from North Michigan Avenue to North State Street, River Street from the southwest plaza of the Michigan Avenue bridge to East South Water Street, West South Water Street from North State Street to West Lake Street, North Market Street from West Lake Street to the alley between Lake and Randolph Streets. A one-level thoroughfare will be built in North Market Street from the alley between Lake and Randolph Streets to the north curb line of Madison Street. The improvement will include approaches in all intersecting streets. The upper level will connect with Michigan Avenue at South Water and River Streets. The upper level roadway is 72 feet wide between Franklin and State Streets, 68 feet wide at the Michigan Avenue plaza, and narrows to 38 feet on South Water Street between Michigan and Wabash Avenues. The two levels are to be connected with three ramps at suitable places. The grades vary from 3 to 5 per cent.

The intention is that the lower level shall be a through street for traffic using the lower level of the Michigan Avenue link bridge. For the use of this traffic, dockage facilities along the river are provided. The docks are to be of concrete supported by two rows of timber piles.

The entire construction, with a few exceptions at the westerly end, will be of reinforced concrete. Most of the old retaining walls are to be enlarged and reinforced. Test drillings have shown that in some cases caissons will have

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FRATERNITIES

In a recent Economics lecture a most surprising fact was brought out through the medium of one of our alumni. This gentleman was in search of Professor Gebhardt's office. Not finding the office where he expected it to be he questioned two Freshmen as to its whereabouts. The Freshmen seemed dumfounded that they of all people should be expected to answer a question so remote from their immature selves. The alumnus ended his interview with some poorly concealed remarks about blind underclassmen and proceeded to unload his troubles upon a sympathetic Dean.

We are perfectly safe in assuming that the same two Freshmen, along with many of their classmates, probably do not know any more about our fraternities than about the location of Professor Gebhardt's office. To these individuals, this article is instructively dedicated.

We regret that this deplorable condition has been brought to our attention so late in the year, but to make amends we will attempt to summarize existing facts in such a manner that they may be easily assimilated. There are ten social fraternities and eight honorary organizations at Armour Institute of Technology.

Alpha Epsilon chapter of Phi Kappa Sigma was chartered in 1898. Their home is at 3420 Michigan Avenue. The national organization was founded in 1850. The growth of the fraternity brought enough alumni members into Chicago to enable them to establish an Alumni Club on Cedar Street, just off Sheridan Road. Here the undergraduates mingle with the older members.

Delta Tau Delta is also a social fraternity, founded in 1859. Gamma Beta chapter was chartered at Armour Institute of Technology in 1901. The chapter was recently afflicted with the wanderlust and now resides at the Lakota Hotel. We are advised, however, that this is only a temporary home.

In 1912 a local organization was born. Sigma Kappa Delta is now located at 3661 Michigan Avenue. A recent fire aided them in cutting the annual coal bill and incidentally wrought havoc with their house. Calamity strengthens the bonds of friendship. Disaster renews the courage of the unconquerable. The members of the organization deserve admiration for their zeal in healing the physical and mental wounds caused by this stroke of ill-fortune.

The second local organization to be founded at the Armour Institute of Technology was Rho Delta Rho. It received its charter in 1920.

The local organization known as Omega Lambda became the Alpha Gamma chapter of Theta Xi in 1922. The national organization was founded in 1860. They own their home at 3305 Michigan Avenue.

The fourth national organization to be chartered at Armour Institute of Technology was Sigma Alpha Mu. Sigma Epsilon chapter was installed in 1922. The national organization was founded in 1909.

In the spring of 1923 the first professional organization at Armour Tech was chartered. Scroll and Triangle, a local fraternity, was installed as the Armour chapter of Triangle. The national fraternity was founded at the University of Illinois in 1907. Armour chapter of Triangle, after shopping among the houses on the Avenue, finally settled at 3222 Michigan Avenue.

In 1923, Beta Phi, a local fraternity, changed its name to Phi Beta Tau. This local organization was later installed as Gamma chapter of Phi Pi Phi. Their house is at 3131 Michigan Avenue.

Sodales, a club organized in 1923, formed the nucleus of another fraternity. Beta Psi was incorporated in August, 1924, and the Beta chapter chartered here.

The Umen, a local club, was organized in 1923.

The oldest honorary fraternity at Armour Institute of Technology is Tau Beta Pi, national honorary engineering association. Beta chapter of Illinois was chartered in April, 1906. Delta chapter of Eta Kappa Nu, honorary electrical association, was chartered in 1909. Edfou Temple of Scarab was chartered in 1915. It is the honorary architectural organization. In 1920, Omicron chapter of Phi Lambda Upsilon, honorary chemical society, was granted a charter. Salamander, honorary fire protection engineering, was organized in 1923. The installation of Beta chapter of Chi Epsilon, honorary civil engineering, took place in 1923. The latest addition to the fold is Delta chapter of Pi Tau Sigma, honorary mechanical engineering.

One organization exists for the recognition of the efforts of the members of the staffs of the college publications. Sphinx was founded at Armour Institute of Technology in 1907, and is the second oldest honorary organization.

The Scarab exhibition of water color, pencil, and pen-and-ink drawings is well under way. The exhibition has been sent to the University of Illinois chapter of Scarab for the first showing, whence it will be sent to all the institutions having a chapter of Scarab, and finally back to Armour chapter for the final judging. The winning exhibits will be reproduced in the leading technical and architectural magazines. The exhibits have been submitted by the students of architecture of the various colleges and universities. N. L. Flint, a member of Scarab, took second place in the Emerson Prize Competition.

The Chicago Alumni chapter of Triangle, in conjunction with the Armour Active chapter, gave an Alumni dance at the Columbus Park Refectory, February 14. The Illinois chapter of Triangle sent its justly famous orchestra to furnish the music for the occasion. The Active chapter followed this event up with the annual Hard Times Dance, on March 2.

Sigma Kappa Delta initiated six new men on January 31. A banquet was given them at the Allerton Club. There was a good turnout of the alumni members. St. Valentine's day did not get by without a party and dance.

Theta Xi celebrated St. Valentine's day by initiating eight new men, and topped the day off with a party. Theta Xi sent L. C. Senescall as a delegate to the annual convention held in New York, February 20 and 21.

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A MESSAGE TO GARCIA

It is only a matter of 1600 words or so, and as a whole they are just common words we all use, but they have been woven together to form a masterpiece. Elbert Hubbard's "A Message to Garcia" was born February 22, 1899.

The suggestion came from a little argument over the teacups when his boy Bert suggested that Rowan was the real hero of the Cuban war. Rowan carried the message to Garcia. Elbert Hubbard arose from the table and wrote "A Message to Garcia." It was run in the *Philistine* without a heading. The edition went out, and soon orders began to come for extra copies of the March issue—a dozen, fifty, a hundred. When the American News Company ordered a thousand, inquiry was made as to which article had stirred up the cosmic dust. The New York Central railroad obtained permission to reprint the article and issued it in booklet form in editions of half a million. Two or three of these half-million lots were sold out and the article reprinted in over two hundred magazines and newspapers. It has been translated into all written languages. A copy was given to every railroad employee in Russia. Other countries took it up, and over forty million copies have been printed.

A wonderful record, and yet there are many who have not read this "preachment" of Hubbard's. If this be true of you, by all means lose no time in removing the defect. Here is the story of Rowan, as Hubbard told it.

"In all this Cuban business there is one man stands out on the horizon of my memory like Mars at perihelion.

"When war broke out between Spain and the United States, it was very necessary to communicate quickly with the leader of the Insurgents. Garcia was somewhere in the mountain fastnesses of Cuba—no one knew where. No mail or telegraph message could reach him. The President must secure his co-operation, and quickly. What to do!

"Someone said to the President, 'There is a fellow by the name of Rowan who will find Garcia for you, if anybody can.'

"Rowan was sent for and given a letter to be delivered to Garcia. How 'the fellow by the name of Rowan' took the letter, sealed it up in an oilskin pouch, strapped it over his heart, in four days landed by night off the coast of Cuba from an open boat, disappeared into the jungle, and in three weeks came out on the other side of the Island, having traversed a hostile country on foot, and delivered his letter to Garcia—are things I have no special desire now to tell in detail. The point that I wish to make is this: McKinley gave Rowan a letter to be delivered to Garcia; Rowan took the letter and did not ask, 'Where is he at?' "

Yes, Rowan was the real hero of the Cuban war, but the question we are concerned with is this: How many of us can carry a message to Garcia? Is your fraternity carrying its message to Garcia?

Here in our little universe of mathematics, physics, chemistry, and all, stand

Continued on page 105

ATHLETICS

WRESTLING AND BOXING

Although the wrestlers have been hard at work since fall, they have had and will have but little opportunity to secure the publicity and recognition due them for their work because only a few meets can be arranged. The few meets that were arranged required a great deal of work on the part of the manager and then after the schedule was completed, postponements poured in so that rearrangement was necessary. The outstanding reason for this is the Conference ruling barring competition with colleges that do not have a rule barring students from the college teams until they have been a resident for at least a year. This eliminates all possibility of meets with Conference opponents until Armour adopts the freshman ruling.

The complete schedule of the season includes only five meets: Northwestern College at Naperville, Northwestern at Armour, "Y" College at Armour, Kent College at Armour, and the American College of Physical Education at Armour. Kent College has consented to include three boxing matches along with the regular wrestling bouts. This should be of great interest because the three Armour men have had considerable experience in boxing and should keep things going till the finish. The boxers are Pate (150), Hamlett (150), and Cailles (100). If possible more boxing matches will be arranged, but if none can be secured the whole boxing season will be concentrated into the Kent meet. A meet with De Paul seems probable and if agreed upon will bring the total wrestling meets up to six—not a very impressive schedule for a team that has practiced five months.

The squad has been handicapped by the loss of Geymer who has been incapacitated by an infection in the hand. His loss has been especially noticeable because, besides being an experienced and consistent man, he is the only heavyweight on the squad who has had any experience in wrestling. Coach Smith has had only a few recruits this year. Luckily they were Freshmen and much will be expected of them during the next four years.

Y. M. C. A. College defeated the Armour wrestlers 21 to 7 in the bouts held at Armour, February 11. The only Armour man to come through with a victory was Eisenberg. His victory was obtained after ten minutes of mediocre work which was sufficient to secure the decision, but unable to gain a fall. The following summary of the matches shows how the remainder of the Armour men fared:

Y. M. C. A. College at Armour

Y. M. C. A. College		Armour		Winner
Filmore	135	Janak	135	"Y," fall
Wilson	145	Eisenberg	145	A, decision
Benninghoff	125	McHenry	120	A, default
Coderio	115	Swanson	115	"Y," fall
Norris	158	Green	158	"Y," decision
Benninghoff	135	Lickton	140	"Y," decision
Gaudy	185	Weisberg	185	"Y," decision
Y. M. C. A.	175			"Y," default

BASKETBALL

After only two weeks of practice the basketball team (if team it could be called at that time) was initiated into the season with a defeat by Notre Dame at South Bend. Both teams showed the effect of the proximity of the football season by their repeated use of football tactics. To the spectator this was the saving feature of the game which otherwise would have been dead and uninteresting due to the poor basket shooting and slow floor work. The football tactics caused so many fouls that near the end all of the speed and pep was gone, leaving the final impression that of a slow and languid contest. The lack of practice and the necessity of it were shown in this game, for the total effort of the Armour squad resulted in only six points. Nyikos of Notre Dame, with nine baskets, did most of the scoring; but even so, he missed many shots that he will be sinking with his eyes closed by the middle of the season. This game seemed to be of exceptional value to the individuals, because each man picked up a few points of the Notre Dame style and has used them to good advantage throughout the season. The scores of the games played to date are:

Armour, 13; Notre Dame, 33.
Armour, 17; Millikin, 23.
Armour, 30; Chicago Tech, 20.
Armour, 18; Augustana, 38.
Armour, 17; Columbia, 27.
Armour, 31; Dubuque, 20.
Armour, 23; Augustana, 17.
Armour, 16; Northern Illinois State Teachers' College, 25.
Armour, 25; Millikin, 30.
Armour, 29; Dubuque, 27.

Millikin furnished two fast, even battles that developed into endurance contests. The Decatur quintet had the stamina to come back and win both games in the second half. In the first game Long stood above the rest (as is natural) and put Millikin ahead with six baskets. "Joie" McLaren kept us in the running with ten points. At the half the score was tied but the break came at the start of the second half, when Millikin started at a bewildering pace and got the lead which they clung to for the remainder of the struggle. The second game was a repetition of the first. In this game Hellgren broke into the scoring with five baskets and a free throw. The scoring of Millikin was contributed by all the members of the team, thus enabling them to accomplish the thing that all coaches preach about—the winning of the game without any individual or "grandstand" play.

The Armour team tasted its first victory in the Chicago Tech game. This game looks good in the score book (from our standpoint), but it really was a listless and long drawn out affair and had but one redeeming feature—Armour won.

The next three games were with Augustana, Columbia, and Dubuque U. These were played on consecutive days and constituted the only long trip of the season. The first two days were enjoyable to the Armour team only as long as they were traveling. Augustana and Columbia were very hospitable until the team got on the court; there the hospitality stopped and the hostility began. Augustana showed no quarter throughout the game—they took the lead from the start and never relinquished it. Augustine was the only pride of Armour with his good defensive work and four points. The whole show really was Mahoney, who aided the Swedes to pile up their large score by contributing nineteen points. With this 38 to 18 defeat to pep them up, the team encountered the Columbia outfit and, although unable to make the game close, they were able to keep the Columbia score lower than the Augustana score. In this game it was Danziger who helped most to pile up the insufficient Armour score.

The Dubuque contest was rough and fast and both teams set a terrific pace throughout the game. It seemed that neither team could keep up their speed but they did to the final whistle and were anxious for more. How anxious they were is told by the second contest, held on the Armory basketball court.

The first home game after the trip was with Augustana who had handed the Armour team their worst defeat of the season. In this affair the Swedes encountered a different team and every play was smothered before it was under way. Mahoney (some Swedish name), the star of the first game, was unable to get through the Armour defense and was held to four points. The end of the game came with Armour leading by only five points. Hellgren led the scorers with eleven points. The next game on a foreign floor was against the teachers at DeKalb where the Armour team learned something — as they naturally should from a group like that. After this defeat, Millikin handed them another and brought the total to six.

When the University of Dubuque squad arrived at Chicago, all of its members were set on wiping out their first defeat. On the floor they supplied plenty of pep and the game proved to be a thriller. The game was fast and rough, with the lead shifting about until the last minute of play when Armour led 23 to 21. Just before the time was up Kaup sank a field goal to tie the score. In the five-minute overtime period Armour came back strong and fought furiously for the advantage. Both teams started a barrage of long and short shots, resulting in scores by both teams until, with the five-minute period nearly ended, Captain McLaren sank the final basket and punctured the hopes of Dubuque with a two point lead. Lineups for the Dubuque games:

Armour (31)

	B	F	P
McLaren, rf	7	2	1
Danziger, lf	3	0	1
Brockman, c	3	0	1
Augustine, rg	1	1	4
Weinwurm, lg	0	0	2
Gaylord, c	0	0	0
Morgan, rg	0	0	0
Totals	14	3	9

Dubuque U. (20)

	B	F	P
Bauman, rf	1	0	0
Malin, lf	2	1	2
Wilson, c	2	1	2
McAleece, rg	2	1	1
Rebal, lg	0	0	0
Crawford, lf	1	0	0
Kaup, c	0	1	0
Vohl, rg	0	0	0
Weigelt, lg	0	0	1
Totals	8	4	6

Free throws missed: Dubuque, 5; Armour, 3.

Referee—Payseur (Drake).

Armour (29)

	B	F	P
McLaren, rf	5	3	1
Danziger, lf	3	3	1
Hellgren, c	3	0	0
Augustine, rg	0	0	3
Weinwurm, lg	0	1	1
Gaylord, lf	0	0	0
Brockman, c	0	0	0
Morgan, rg	0	0	1
Totals	11	7	7

Dubuque U. (27)

	B	F	P
McAleece, rf	1	0	1
Malin, lf	3	0	2
Kaup, c	5	1	1
Weigelt, rg	0	0	4
Wilson, lg	3	1	2
Bauman, rf	0	0	0
Wieland, lf	0	1	1
Rebald, rg	0	0	1
Totals	12	3	12

Free throws missed: Dubuque, 4; Armour, 5.

Referee—Kearns.

BASEBALL

The coming baseball season holds more hopes for Armour than can be expected of any in the near future because the '24 team is practically intact. One of the big advantages this year is in our coaching; there will be three coaches—yes, three. This is hard to believe, but it is a fact. The plans are to have Henry Penn, last year's coach, take care of the drilling of the pitchers while Schommer and Kraft handle the infield and outfield. Coach Penn has his work well under way at this time and should have three or four men ready to pitch a few innings as soon as the weather permits outdoor work. Ruzich is the only man left of the '24 squad who did any consistent pitching last year. Judging from his record, he should make an enviable record in this, his last year on the diamond. Of the new men, three or four seem good in the gym—but we always have a bunch of these "gym pitchers" who act like hothouse plants and fade away as soon as they strike the air. The usual trouble is a sore arm—so take warning, pitchers, and protect your "salary wings."

Coach Kraft needs no introduction, as every one of us has been in his classes at one time or another. He and Schommer will drill the men in the fundamentals of the game. The method will consist of work, work, and more work until the basic actions and reactions have been imparted to the squad—and then the season will be over. This is not Schommer's first appearance on the Armour diamond as coach. When he did coach, Armour always had a baseball team that was feared by all the college teams in the country. He is going to stage a comeback this year if the team will respond with as much pep and energy as he will put into the game. If anyone can put pep into teams, or the faculty, or what-not, it's Schommer.

The reason for the prediction of such a good season is based upon the fact that, besides the infield and outfield being intact, there will be a former captain trying to push one of the outfielders out of a job. Former Captain Desmond, who did not appear on the diamond last year, will be out there this year and will be a great help in the pinches. Plocar, '24 captain, may have some difficulty in playing because of an injury sustained in football two years ago. If he is unable to play there will be a gap in the lineup that will be difficult to fill.

The infield will probably present the same appearance as last year and should show a better brand of team work than is usually seen on the Armour field because it is rather unusual for the same infield to appear on the diamond for two years. Last year the lineup was Hofer, first base; Downes, second; Geiger, shortstop, and McLaren, third. This is Hofer's second year of baseball and, as one of the leading hitters, he should be a treat to the A. I. T. eyes. Hofer made a success as a first baseman although he had always done his playing in the outfield until last season. Downes has developed into quite a hitter and due to his speed should cross the home plate many times during the season. McLaren turned out to be our home run hitter last year, but everyone will be satisfied with four singles for each home run.

Captain Burke, Schonne, and Harrower are in for a warm time trying to keep Bill Desmond from getting possession of one of the gardens. Burke, who did not drop a fly last year, will probably have the best season of his career on Ogden field and it is hoped that he can graduate this June as the captain of a victorious team. The most spectacular slugger on the team should be Schonne, according to the records of '23 and '24, which show him to be a consistent and heavy hitter.

The preparation of a schedule has been under way for some time under the guidance of Kovarick who was chosen as manager from a large number of applicants. His list will not contain the names of any of the "Big Ten," such as Wisconsin and Chicago unless the freshman rule is adopted. It has been the custom to open the season with the Wisconsin game and so a tradition seems doomed this year.

This season will be the last appearance of five men of the squad, for graduation will call away Captain Burke, Plocar, Ruzich, Desmond, and Geiger, all of whom have been members of the A. I. T. team for three years and are now starting the fourth. It will be only just to come out and watch and cheer these men who have given up their time for four years so that they might be fit to represent Armour on the diamond.

FRATERNITIES

(Continued from page 103)

It is rumored that the Umen will soon be affiliated with a national fraternity, and that the announcements will be out shortly.

Six men were initiated into Phi Kappa Sigma, January 31. It is reported that the Phi Kap mid-semester house party was put over in great shape, in spite of the fact that the grades were received on the same date, January 24.

The Sphinx initiation was held February 6, and the following men were initiated:

G. D. Arachovitis
E. R. Hubbell
E. H. Marhoefer, Jr.
E. M. Meyer
C. M. Nelson
W. H. Sothen
D. R. Stiehl

The second semester officers of Tau Beta Pi are:

President	A. L. Stemwedel
Vice-President	E. M. Meyer
Treasurer	E. W. Odenwaldt
Recording Secretary	W. H. Sothen
Corresponding Secretary	E. S. Larson
Associate Editor of "The Bent"	A. A. Andersen

Pi Tau Sigma has selected the following officers:

President	G. S. Maffit
Vice-President	E. W. Odenwaldt
Treasurer	E. G. Benson
Recording Secretary	C. M. Rowley
Corresponding Secretary	H. W. Regensburger
Faculty Adviser	D. Roesch

Chi Epsilon has the following officers:

President	S. R. Wiley
Vice-President	R. L. Lawson
Treasurer	E. R. Gritschke
Recording Secretary	J. P. Frisch
Corresponding Secretary	W. J. Dixon

A MESSAGE TO GARCIA

(Continued from page 103)

our fraternities with a definite duty to perform. They form the nuclei for so many of those delectable morsels of social life which help to break the monotony of recitations, experiments, and quizzes. In the fraternity houses start many of the events which are to spread through the entire student body. In the fraternity it is discovered that a pledge is a second Beethoven, or a Kreisler, and thereupon he is pushed into the orchestra to become one of the mainstays of that organization. The man may be a baseball player, or a tennis champion, but he is there, he must be discovered, and his talents must be directed where they will do the most good for the entire student body and the Alma Mater.

Every fraternity has its own message to carry. Do it, and put "A Message to Garcia" in your library where all may read it.

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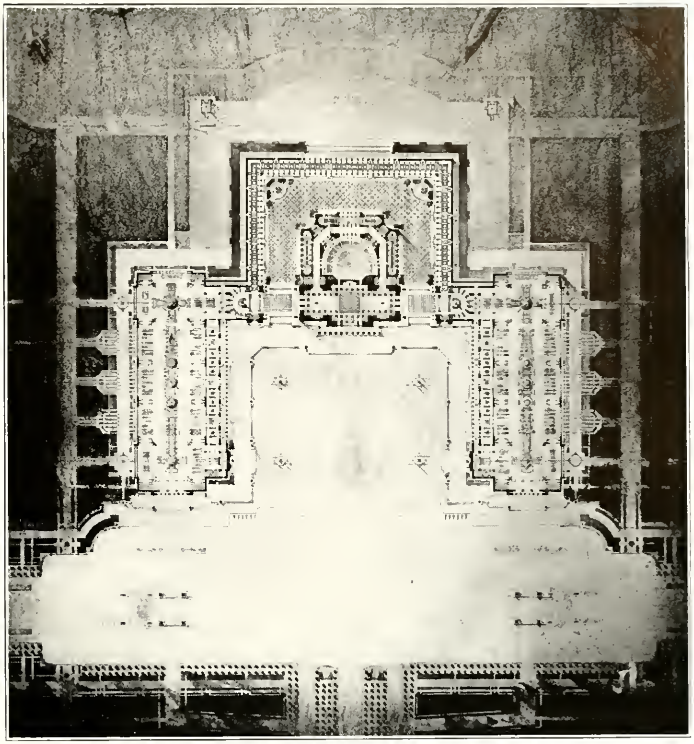
RECENT SUCCESSES OF THE DEPARTMENT OF ARCHITECTURE

(Continued from page 96)



"A Transportation Institute." Plan of Mr. Bieg's prize drawing.

experts, and others and furnish them with sufficient money to pursue their research uninterruptedly. He wishes also to furnish them with grounds, buildings, workshops, and laboratories in which their inventions may be tried out under the most favorable circumstances and with the assistance of a staff of highly trained mechanics and workmen.

"He has therefore established a foundation to be known as the Institute for the Advancement of the Science of Transportation and has issued a program for the purpose of securing a set of plans for these buildings which are open to the public."

The buildings were to be (1) a Hall of Honor and of Assembly, (2) a Hall of Past Achievements, and (3) a Hall of Current Inventions. The Hall of Honor and of Assembly was to contain a monumental gallery, rotunda, or pantheon; a large assembly hall; two smaller lecture halls; a library; and a small administrative suite. The Hall of Past Achievements was to consist of a great hall for models of ancient and modern means of transportation, as well as small alcoves for minor exhibits. The Hall of Current Inventions was to provide a great hall and smaller exhibition rooms where recent advances in the science of transportation might be displayed. Space outside the building was to be devoted to objects not injured by exposure. The nature of the site chosen for the project made available great spaces for laboratories, airplane and dirigible hangars, experimental fields, rail sidings, piers, dry docks, and experimental basins. The composition was to be completed by a court of honor, by ample circulations, and by pools and fountains.

Harry Kurt Bieg's problem showed superior knowledge in plan and in modern construction and revealed an intimate sense of the comparative importance of circulations. His plan and elevations had good "scale" and were beautifully presented. A feature of his design wherein it differed from the others was a graceful steel shaft or tower over the Hall of Honor, dominating the whole composition. This tower was to be used for radio experiments. This part of the design was inferred and greatly contributed to its success. Bieg is now in Paris in Atelier Redon.

To look backward is to speculate on the future. Mr. Edmund S. Campbell, to whom a large share of the credit for our success in the past is due, has left us to assume the duties of Dean of the Beaux-Arts Institute of Design in New York. But his work is carried on by the new Head of the Department, Mr. Earl H. Reed. Mr. Lautz and Mr. McCaughey continue to mould honor men under the present regime. The staff has received "new blood" in the persons of Messrs. Smith, O'Connor, and Nedved. There is great enthusiasm on the part of the students and from the seriousness of their efforts we know their goal is high. Five Armour men were excused from the First Preliminary of the Paris Prize this year. It is just a question of which man has the stamina, the courage, the mettle to face the test and survive—even the grit to take failure and come back and win the greatest architectural honor in the United States.

FIRE ALARM SYSTEMS

(Continued from page 91)

of the globes; some have red upper glass for the gas lamps. In New York the boxes are now surmounted with a pedestal carrying a tungsten lamp, with a large red glass around it. They are very conspicuous and visible for a long distance. There are few street corners from which at least two boxes are not in sight.

It is sometimes expensive to maintain special lights at each box location. Some cities have managed this economically by using low-voltage direct current, carried in the same cables with the fire alarm wires, and supplied from the fire alarm batteries or from a motor-generator set. In this way there is no chance for high-tension current to enter the fire alarm cables. Where proper size of wires is used, this appears to be a safe method. It would not, of course, be safe to use secondary current from a transformer on account of the possibility of introducing high-tension into the fire alarm cables. Another city places small transformers on the 110-volt lighting circuit, and steps down the voltage to 12 volts for groups of fire alarm and police boxes—red on the fire and green on the police. Means are provided to flash these lights for calling patrolmen.

We have now considered the boxes at which fire alarms originate. In the next issue we shall take up the circuit over which the signal is transmitted to the central office and through the office to the fire station.

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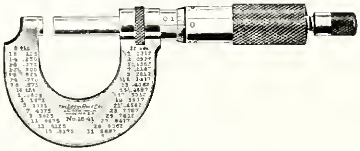

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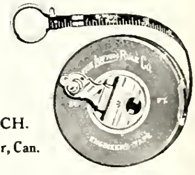

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TRANSMITTING EQUIPMENT
FOR RADIO TELEPHONE BROADCASTING

(Continued from page 94)

The advantages of the condenser transmitter are its somewhat better frequency characteristic and its freedom from carbon noise. For laboratory purposes and for the high quality transmission of the most difficult types of music it has, therefore, found some application. As has been indicated above, however, approximately five stages of amplification are subsequently required to attain ordinary telephone volume levels. The rather small capacity of the instrument (of the order of 400 mmf.) also represents a more or less serious limitation to the extent of requiring cables between the transmitter and the amplifier, having a very low electrostatic capacity.

The principal requirements to be met by the amplifiers associated with the telephone transmitter in the input equipment are those relating to frequency range, volume range, and noise level. These have already been discussed. A further matter of some importance is that concerned with amplification control. The necessity of providing for manual variation in amplification to reduce the range in volume in the higher powered stages has already been mentioned.

The radio transmitting equipment must afford means of generating alternating currents of a frequency corresponding to the operating wave-length, means for modulating these currents faithfully in accordance with the desired transmission, and suitable radiating means, in the form of an antenna.

The vacuum tube oscillator in its present form is a very satisfactory solution to the problem of generation. Since a broadcasting station usually operates on a single assigned wave-length, a relatively simple circuit arrangement can be employed. Under the present regulations, however, all coastal stations must be capable of transmitting for ship emergency service on wave-lengths of 300 and 600 meters. The equipment must therefore admit of adjustment on occasion to these wave-lengths.

Other requirements arising from the provisions of the radio regulations relate to frequency stability and to freedom from harmonics. Frequency stability is an almost essential prerequisite to the success of any scheme looking to the intensive utilization of the ether such as has been put into effect within the past year. If stations are to be successfully operated with frequency intervals between adjacent wave-lengths as small as 10,000 cycles, a high degree of constancy in this respect must obviously be maintained, not only during the course of any individual program, but also from day to day and from month to month. For those who have not had the privilege of listening throughout an entire evening to the beat note from a distant transmitter superimposed with exasperating steadiness upon the program of their favorite broadcasting station, it may be stated that if proper precautions are taken, no difficulty is ordinarily experienced in holding the frequency constant within the limits at present specified, that is, 2000 cycles. Since common use is made of transmitters in which the antenna forms part of the oscillatory circuit or is coupled thereto, it is evident that such performance requires the antenna to be so secured that even the effect of a high wind will not bring about a material change in its constants.

With respect to freedom from harmonics, the present regulations covering broadcasting stations merely contain the provision that the transmitted wave shall be free from harmonics. Unfortunately, this requirement is very nearly an exact statement of the case. The sensitivity of modern receiving equipment and the extremely small amount of power necessary to produce an audible beat note require the suppression of harmonics to a most unusual degree and render the problem exceedingly difficult. Apparently satisfactory performance is now being attained, however, through the use of properly designed coupled circuits.

Primarily, the system of modulation employed in a broadcasting transmitter must be one which will enable it to meet the rigorous transmission requirements. On account of its excellence in this respect, as well as its simplicity, the arrangement commonly known as the Heising constant current or "plate" modulation had found extensive application. In this system, the amplified transmission is superimposed upon the direct voltage impressed upon the plate of the oscillator tubes. Under these conditions, the output voltage of the latter varies proportionally, producing the desired modulated radio-frequency current in the antenna circuit.

The power equipment for a radio broadcasting station is subject to no requirements of an unusual nature, with the possible exception of freedom from electrical noise. This factor is of no little importance, however, and exercises considerable influence on the choice of power sources for use in the various circuits.

In broadcasting, to an even greater extent perhaps than in other amusement enterprises, the program must go forward smoothly and briskly to obtain the most favorable reaction from the audience. Delays of even a relatively few seconds often become painfully evident since the sense of hearing alone is involved, and as soon as the transmission is interrupted the listener is beyond the influence of the personality of the entertainer. It is of primary importance, therefore, that such facilities as are required to expedite the program to the utmost should be provided.

The control equipment required depends largely upon the class of service in which the station operates. The smaller stations necessarily serve a limited audience and often employ considerable mechanically reproduced music. Under these conditions, the simplest possible arrangement will generally suffice. On the other hand, many of the larger stations now number their audiances in tens of thousands, and the talent available often includes figures of national or international prominence. Two or more studios are frequently employed, and the use of wire line connections to outlying points is finding increasing application. Under such circumstances a well worked out control system is essential.

In general, the facilities required may be classified into three separate groups. In a broadcasting station, it is just as important to close and open the circuit promptly at the proper time as it is to raise and lower the curtain in the theatre. There is also the problem of insuring that nothing but the desired transmission is broadcast, since failure in this respect undoubtedly detracts materially from the artistic effect produced and often results in considerable embarrassment to the station presonnel or to the talent. These conditions require that control over the outgoing transmission be vested in the studio director or announcer and that suitable provision be made in the studio for this purpose. The apparatus employed, in addition to the necessary keys and relays for circuit control, must include suitable indicating means, such as a series of signal lamps, so that circuit conditions at any particular instant will be evident to all persons involved.

Another requirement arises from the close co-operation which must be maintained between the studio and operating personnel and the fact that in many

(Continued on page 112)

OUR NATIONAL DEFENSE POLICY

(*Continued from page 87*)

through a realization of this that we have come to the statement of a military policy as contained in the National Defense Act.

Now let me explain briefly what the National Defense Act is, and how it is applied to secure the intended provision for defense. Bear in mind that the term "militia" designates not the National Guard alone, as is commonly supposed, but the military man-power of the nation, made up of all the able-bodied men between the ages of 18 and 45. Numbering at the present time some twenty-three millions, the militia is divided into a comparatively small organized force, comprising the Army of the United States, and a vast reservoir of untrained manhood. Provision for adequate national defense involves the problem of preparing the organized portion of the militia for its defensive task, and of formulating the plans whereby the great bulk of the unorganized militia may be shaped into an effective force in an emergency.

The War Department, as a branch of the Executive division of the National Government, is charged with carrying out the provisions of the law with respect to national defense.

The Army of the United States consists of three components—the Regular Army, the National Guard, and the Organized Reserves. This is the organization provided for in the National Defense Act. Prior to the passage of this Act the War Department was unable to pursue a progressive military program for defense, but was principally occupied with keeping the small Regular Army up to a high standard of efficiency in the execution of the missions assigned to it. Now, however, with the National Defense Act based on the conception that national defense means unified, co-ordinated, nation-wide effort, the War Department is enabled to lay plans for devoting the resources and man-power of the Nation to the needs of defense in time of national danger and to develop the means whereby those plans may be put into effect.

The Regular Army is a comparatively small sub-division of the Army of the United States. Its size is regulated by the appropriations made annually for its support, and now consists of 139,000 officers and men, including 7000 Philippine Scouts. It has a number of missions in time of peace, chief among them being the maintenance of an efficient mobile force to meet a sudden emergency, the development of a cadre or skeleton organization which can provide trained personnel for key positions in an expanded organization, the maintenance of our overseas garrisons, and, of increasing importance under the National Defense Act, the organization and training of the other components of the Army of the United States.

The National Guard comprises the organized portion of the militia. In time of peace it is maintained as a State force, for local uses, and as such is under the control of the chief executives of the various States. The Federal Government provides certain supplies and training facilities, including a number of instructors from the Regular Army. In time of national danger the President may call the National Guard portion of the Army of the United States into active service of the Federal Government, and when it is so called it assumes a status corresponding to that of the Regular Army. The National Guard at present numbers about 177,000 officers and men.

The Organized Reserves, which would in an emergency comprise the bulk of the Army of the United States, includes that portion of the organized militia not a part of the Regular Army or the National Guard. In time of peace the Organized Reserves consist of reserve officers, non-commissioned officers, and enlisted specialists, who form a skeleton organization about which the nation's man-power may be readily and efficiently molded, trained and assimilated when it is called to duty and mobilized for a national emergency. At the present time the personnel enrolled in the Organized Reserves comes mostly from those men who served the country during the World War. But as time goes on and these men pass out from the period when they are available for the military service of the nation, others must be supplied from the youth of the country as it grows to manhood and to participation in the service of the nation.

To accomplish the preparation of the young men of the country for the share which they must bear in the service their citizenship entails, the Government has established such agencies as the Reserve Officers' Training Corps and the Citizens' Military Training Corps, known in abbreviation as the R.O.T.C. and the C.M.T.C. The R.O.T.C. is conducted through cooperation with certain schools and colleges throughout the United States, in which units of the R.O.T.C. are established for the training of students enrolled at those institutions. The Government furnishes officers and enlisted men as instructors, arms and other equipment, and money, to carry on the military instruction. Credit is given toward graduation, and qualified graduates are appointed in the Officers' Reserve Corps.

The Citizens' Military Training Camps are conducted at various designated military posts throughout the country for a few weeks during the summer, and give those young men who volunteer for enrollment an opportunity to receive a limited military training, together with an acquaintance with the obligations of citizenship, and understanding of the military policy of the Nation, and a broadening of view which comes from association with their fellows in the common service of the country. The Government supplies transportation between their homes and the camps to which they are assigned, shelter and subsistence while they are in attendance at the camps, and provides uniforms, arms and equipment, and instruction.

With the proven knowledge that the Nation may no longer rely for its defense upon a small detached armed force, but must enroll every citizen and every dollar and must direct every effort toward the Nation's need, the National Defense Act has provided a systematic plan for preparing the forces, individual and material, of the country for the emergency which they may be called upon to meet. We have, after more than a century and a quarter of failure to adopt and apply an adequate military policy for providing, efficiently and economically, the means for the common defense as intended by the Nation's founders, at last laid down a policy and plan whereby the War Department may, with the support of the people and their legislators, carry out a system of national defense that will meet a national emergency.

Chicago Uses Superpower

On last December 11 the peak demand for electric power in Chicago was 688,000 kilowatts, or nearly one million horsepower. The twenty-four hour energy demand was over ten million kilowatt-hours.

The new Crawford Avenue plant in Chicago, now in partial operation, will, when completed, have a capacity nearly as great as the total possible power available from the much discussed Muscle Shoals.

There is now an interconnection between central stations in Illinois, Indiana, Kentucky, Michigan, and Wisconsin by means of which power may be transferred to meet the load demands.

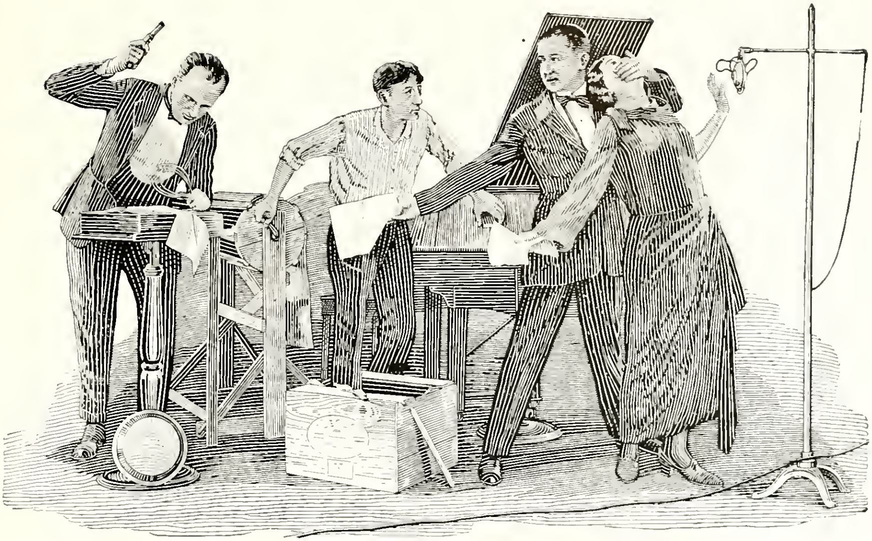
Power Plant Engineering.

Development of a Rust-proof Iron

Chrome-iron having rust-proof properties is reported to have been manufactured in Sweden. The new alloy is of a silver white color and has all the characteristics of soft iron. It is made by mixing Swedish iron with a certain amount of ore found in South Africa.

A roof covered with this material, it is estimated, will cost only fifty per cent more than one covered with galvanized iron. The new roofing does not require painting as a rust preventive.

Machinery.



Stage directions for this scene from William Vaughn Moody's play, "The Great Divide," call for a woman's muffled scream, a pistol shot, and the crash of breaking furniture. The microphone on the right sends them all to your home.

An Exciting Evening

Here are four of the WGY Players (the world's first radio dramatic company) at a thrilling climax that almost turns sound into sight.

Tune in, some evening, on one of their productions. You will be surprised to find how readily your imagination will supply stage and setting.

WGY, at Schenectady, KOA, at Denver, and KGO, at Oakland, are the broadcasting stations of the General Electric Company. Each, at times, is a concert hall, a lecture room, a news bureau, or a place of worship.

If you are interested to learn more about what electricity is doing, write for Reprint No. AR 391 containing a complete set of these advertisements.

DH

GENERAL ELECTRIC

GENERAL ELECTRIC COMPANY, SCHENECTADY, NEW YORK

TRANSMITTING EQUIPMENT

(Continued from page 109)

stations the studio and the operating room are widely separated. A suitable intercommunicating telephone and signal system is almost an absolute essential. Both audible and visible signals are desirable and suitable means must be provided to prevent such signals from being broadcast.

A third requirement relates to monitoring facilities. The operator of a radio broadcasting station has considerably more important functions than those of telegraphist, "trouble shooter," and wireman. Not only is he the critic upon whom the studio director in most cases must depend for information concerning the effect which is actually being presented to the audience, but also, through his control of the input volume, he himself contributes materially to the excellence of the program or tends to spoil it entirely. It is quite necessary, therefore, that he be provided with suitable apparatus to enable him to obtain the desired results. Preferably these should take the form of a suitable loud speaker equipment arranged for monitoring the output of the speech amplifier and, by means of a suitable rectifier, the radio-frequency output of the transmitter.

In so far as receiving apparatus is concerned, the requirements to be met are at best somewhat indefinite. Since a large number of broadcasting stations may be classified as "coastal stations," however, equipment suitable for maintaining the receiver watch required by law is essential. In this connection, the original practice, it will be remembered, involved an interruption of the program every fifteen minutes for three minutes to "listen in." Such a procedure was necessarily of short duration and in almost all stations facilities are now provided to permit of reception on 600 meters while the local transmitter is in operation. This requires a separate receiving antenna and imposes certain restrictions upon the design of the receiving apparatus. In addition to its use in the reception of telegraph signals, it is also desirable that the receiver be suitable for employment in the broadcasting range and be capable of the high quality reproduction of speech and music, since on occasion it may be employed to considerable advantage to supplement the regular monitoring facilities and to hear the programs from other stations.

THE IMPORTANCE OF FINANCIAL TRAINING

(Continued from page 92)

ery and improved his "fixed assets" and wondered why banks wouldn't loan him more money on his equipment.

7. Company in financial trouble on account of heads not understanding the difference between "capital" and "bank loans."

The greatest requirement that I know of that a man entering a mechanical or technical business needs, is to be "well-rounded out" in his attainments. By this I mean, that he must thoroughly understand the commercial and financial side of business, along with his special training in engineering, manufacturing or construction.

Most of my clients have learned their lesson after toiling a great many years at their particular industry. Statistics showing the number of failures of men between the ages of 35 and 50 are staggering—likewise are the data revealing the number of concerns who are attempting to operate upon an inadequate capital structure.

A broad-gauged executive who makes a success of his business enterprise, understands the importance of and keeps his finger on the pulse of his operations by his knowledge of the following points.

1. Amount of absorption of his product in the market, and its fluctuations during the season.
2. The necessity of keeping the condition of the company sufficiently liquid to avoid financial embarrassment by action of his creditors.
3. The inadvisability of overstocking his inventory at times when its value is subject to unusual fluctuations.
4. The factors that determine his borrowing power, such as relations of liquid assets to current liabilities, earning power and financial statement.
5. The need of a suitable cost system, which will actually reflect the true condition of his operations.
6. The necessity of a rigid credit and collection system.

No matter what engineering skill is employed in a plant; regardless of the efficiency and ability of the sales organization; in spite of modern methods and modern equipment that may be utilized, if these necessary adjuncts to a sound business policy are not correlated to a very definite financial program, you may expect trouble when an accounting is had.

THE GREAT AMERICAN CITY OF THE FUTURE

(Continued from page 88)

the lake district of Northern Indiana, and at many points throughout the region where hilly wooded land or beautiful marsh land like the Skokie Valley is still available. In addition to these public recreational facilities there will be scores of golf courses and there should be great areas of thousands of acres retained for truck gardening, small farming, and for the sake of the open space dividing built up centers.

The smaller city and town parks and playgrounds will probably have to be provided by the towns themselves. In fact in addition to the large scale planning for the entire region in general, each of the incorporated municipalities should study its problems and produce with the advice of a specialist in this field development plans for its own future. These plans should cover streets and roads in co-ordination with the highway program for the region and the neighboring towns; railroad grade separation; station development; parks; playgrounds and athletic fields; public services such as drainage and water supply; traffic regulation and parking facilities; and zoning to control the use of land areas, and to protect property owners in the fair use of their holdings.

As a matter of fact a great many of the towns in the Chicago region have already prepared or undertaken to prepare their zoning plans and general development plans. All of the North Shore towns, most of the western suburbs and several of the communities in the southern district have developed enough community intelligence to realize the necessity and advantages of such planning for the future.

From this brief statement it will be realized that the whole program for the regional development of the forty-five hundred square miles tributary to Chicago involves a new conception of city building. It involves extensive study and surveys of large and intricate problems. It promises the development of a regional community which will meet the requirements of human life in a way that, up to this time, great cities have failed to do.

Navy to Use 80-kw Vacuum Tube

The Bureau of Engineering of the United States Navy Department has awarded a contract to the General Electric Company for the manufacture of an 80-kilowatt electron tube transmitter. This powerful radio-telegraph transmitting device will, when completed, be installed at either one of two high power naval stations, San Diego or Mare Island.

It is understood that three of these 80,000-watt tubes are being manufactured.

Wireless Age.

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Southwest Cor. 33rd and State Sts.

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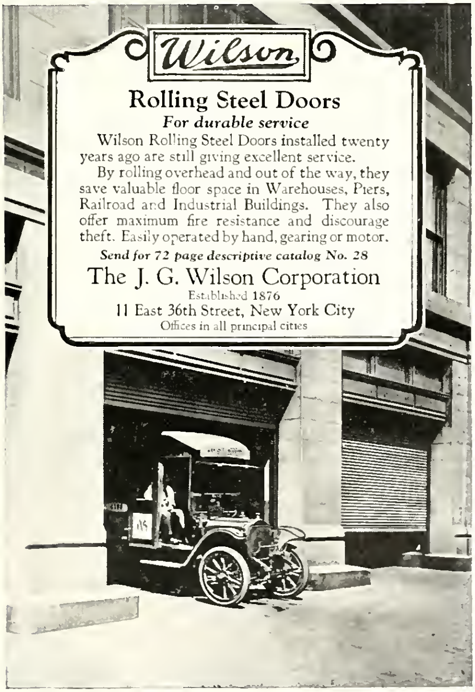

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Rolling Steel Doors
For durable service

Wilson Rolling Steel Doors installed twenty years ago are still giving excellent service.

By rolling overhead and out of the way, they save valuable floor space in Warehouses, Piers, Railroad and Industrial Buildings. They also offer maximum fire resistance and discourage theft. Easily operated by hand, gearing or motor.

Send for 72 page descriptive catalog No. 28

The J. G. Wilson Corporation
Established 1876
11 East 36th Street, New York City
Offices in all principal cities

Resists Corrosion

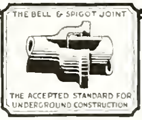
THIS picture, taken in the salt marshes near Kearny, N. J., shows two lines of 30-inch Cast Iron Pipe replacing pipe made of other material. The alternate exposure to the action of salt water and air is a severe test.

While the pipe shown in the picture is subjected to unusual corrosive influences, all underground pipe must be able to withstand corrosion to a greater or less degree. Cast Iron Pipe has this quality. It does not depend on its coating to resist rust; the material itself is rust-resisting. The first Cast Iron Pipe ever laid is in service today at Versailles, France, after two hundred and sixty years' service.

THE CAST IRON PIPE PUBLICITY BUREAU
Peoples Gas Bldg., Chicago

CAST IRON PIPE

Our new booklet, "Planning a Waterworks System," which covers the problem of water for the small town, will be sent on request



Send for booklet, "Cast Iron Pipe for Industrial Service" showing interesting installations to meet special problems

THE AERONAUTICAL ENGINEER

(Continued from page 99)

find a useful place in the general development of air navigation.

The United States Air Mail Service is understood to be the most striking example in the world of the results it is possible to obtain with careful design and construction engineering, combined with rigid inspection and maintenance, and a highly trained and enthusiastic personnel. Already the service has reached such a high rate of efficiency in both night and day flying that it has become commonplace and but little is heard about it. It is not too much to assume that private enterprise may bring civilian flying to a corresponding high state of efficiency, that every city and town will have flying fields, and that passenger and express carrying by air may soon become as commonplace as the air mail is now.

From the bills now in Congress it is possible that we may soon have private flying, especially passenger carrying, under some form of regulation. This will no doubt be beneficial and promote safety, but it is desirable that such regulation should not hamper or tend to smother inventive genius.

All of these activities and tendencies point to an increased demand for aeronautical engineers in the near future. A student in a college of engineering, who has completed the necessary courses in mathematics and mechanics, can get the fundamentals of the subject of aeronautics in a half-year of five hours per week. Since 1910, Armour Institute of Technology has had well attended classes in aeronautics, the subject being offered as an elective. Aside from the matter of remunerative employment for graduates, colleges should consider it a patriotic duty to encourage the study of aeronautics, because in the case of another national emergency there will be more need than ever before for such knowledge.

"US ENGINEERS DON'T NEED NO ENGLISH"

(Continued from page 98)

This is another example of a writer with very little knowledge of his subject, but it also shows a complete lack of logical arrangement. Unrelated statements are tied together with a conjunction, but they serve no useful purpose and the result is nothing but confusion. No capable engineer would start to build a bridge until it had been planned to the last detail. He will often, however, start to write some important document with no plan, no logical arrangement, in mind. He may be a master of his subject, he may know and observe all the rules of grammatical construction, the entire verbal resources of the language may be at his disposal, and yet the result is little better than a hodge-podge. Engineers sometimes wonder why they study logic, but if it teaches them logical sequence in their spoken or written treatment of a subject, it comes close to being the most valuable subject in the entire curriculum.

Professor Huntly, unofficial employment agent for Armour Tech, replaces the telephone receiver on the hook and turns again to his overloaded desk. "There's a good job for some young graduate; the particular course that he took doesn't matter much, and he need not have been an "A" man in his studies; but he must be able to write a good letter, he must know how to present a proposition, orally or in writing, in an attractive and convincing way. Where am I going to find such a young man?"

If students of engineering could only realize the vital importance to them of a command of good English, could understand what a large factor it is in nearly every substantial success, they would soon forget the foolish notion that "us engineers don't need no English."

THE ARMOUR ALUMNUS

(Continued from page 98)

cars are built in factories equipped almost entirely with American machine tools.

Earl K. Zinn, '20, is with the Hindry & Knight Co., Tampa, Florida.

Meredith F. Lawrence, '12, is a representative of the General Motors Corporation, San Paolo, Brazil.

Harold Ingrahm, '17, is supervising engineer on a large construction project at Stockton, California.

William C. Dunn is with the Michigan Crankshaft Company, Detroit, Michigan.

Merle Nutt, '23, is running the Moline Iron Works, Moline, Illinois, assisted more or less by his father.

Our general secretary, Mr. R. A. Goppelsroeder, asks for assistance in locating men on his "missing list." These are the ones who do not receive mail addressed to them at the last address we have. The list below is supplied by the secretary, giving the name and last address of the "lost, strayed, or stolen." Please look this list over carefully, and if you know where any of them are, kindly notify R. A. Goppelsroeder, 251 Conway Bldg., Chicago.

Name	Last Address
Alice Orme Smith	8 E. Elm St.
Lloyd Quayle	3420 S. Michigan Ave.
Richard H. Bates	6757 Chappelle Ave.
Walter King Flavin	917 N. Sacramento Blvd.
Maurice Davis	1138 S. Sacramento Blvd.
Douglas Fletcher	Blue Island, Ill.
Allen W. Carlyle	2210 Prairie Ave.
A. L. Carver	1424 E. 53rd St.
McDonald Darnell	6736 Cornell Ave.
Julius L. Dorsky	1510 W. 13th St.
A F Foley	521 S. Leavitt St
Joseph H. Frank	5803 Indiana Ave.
Elias Georgevich	1125 Webster Ave.
Irving Holtman	828 S. Wabash Ave.
L. Arthur Hower	3636 Michigan Ave.
Charles John Johnson	4100 Prairie Ave.
Lyman D Judson	National Lead Co., Chicago
Henry E Karow	3321 Cottage Grove Ave.
J. Krill	109 Grave Court
T F. McCloskey	111 W. Washington St.
Max William McKone	3253 Michigan Ave.
Francis Montgomery	1171 E. 61st St.
Max Myers	1333 W. Congress St.
Henry A Nemeroff	1514 S Central Park Ave.
Clarence G Nicklin	4115 Broadway
Marshall E. Przbylski	1246 N. Robey St.
John Howard Raferty	149 E. Ontario St.
J. R Richardson	915 Cornelia Ave.
Alexander F. Robertson	Illinois Steel Co., Chicago
F. G Shay	5017 Prairie Ave.
R. W. Sisler	6039 University Ave.
Charles Sobel	900 N. Fairfield Ave.
John P Soltis	3614 Michigan Ave.
S. J. Stoker	6715 Indiana Ave.
Paul Tilds	5223 Winthrop Ave.
Edward Lewis Wells	1407 E. 53rd St
Wallace E Yerkes	1212 E 54th St.

The South Water Street Improvement

(Continued from page 102)

to be sunk as deep as 122 feet. At the intersection of Lake and Market Streets the structure is carried on a frame of subgirders 11 feet deep. Due to the presence of tunnels in the street these girders had to be cantilevered to support some of the columns of the superstructure. All floor construction is of the flat slab type, and is supported by columns on piers or girders carried by piers. There are in all four rows of columns on the lower level, except on the section east of State Street, where the arrangement differs because of the varying roadway width. The columns divide the lower level roadway into three sections of 32 feet 6 inches each. The middle section is intended for through traffic, and the outside roadways are for the use of the slower local traffic. The reinforced concrete columns are to be octagonal in section, and are to be provided with quarter-inch steel protecting plates. The bases of the columns are to be protected with cast iron wheel guards at least five-eighths of an inch thick and rising one foot above the surface of the street.

The lower level thoroughfare will be freed from gases and exhaust from factory plants by a ventilating system of the exhaust type operated from three plants at State Street, La Salle Street, and Lake Street respectively. The foul air will be sucked in from the street through registers in the curbs. The sidewalks will have high curbs so that they may serve as loading platforms, and at the same time the space under the walks will serve for ventilating ducts. The draft in these ducts will be maintained by a motor driven fan at each of the three ventilating plants. The largest of these fans will be driven by a 165-horsepower motor, and will have a capacity of 218,000 cubic feet of air per minute at a draft of 1¾ inches of water. The ventilating ducts themselves will consist of large, hollow, rectangular boxes of reinforced concrete. The tops will serve as sidewalks and are given a cement finish, while the sides are to serve as curbs and are fitted with cast iron ventilating registers set in the concrete. The curbs are provided with bumpers consisting of oak timbers to which are bolted steel bumper plates.

The minimum headroom in the lower level is 12 feet 4 inches. Architectural refinishing work will be done largely with Bedford stone with rubbed finish, as advocated by the Chicago Plan Commission for all river-front improvements.

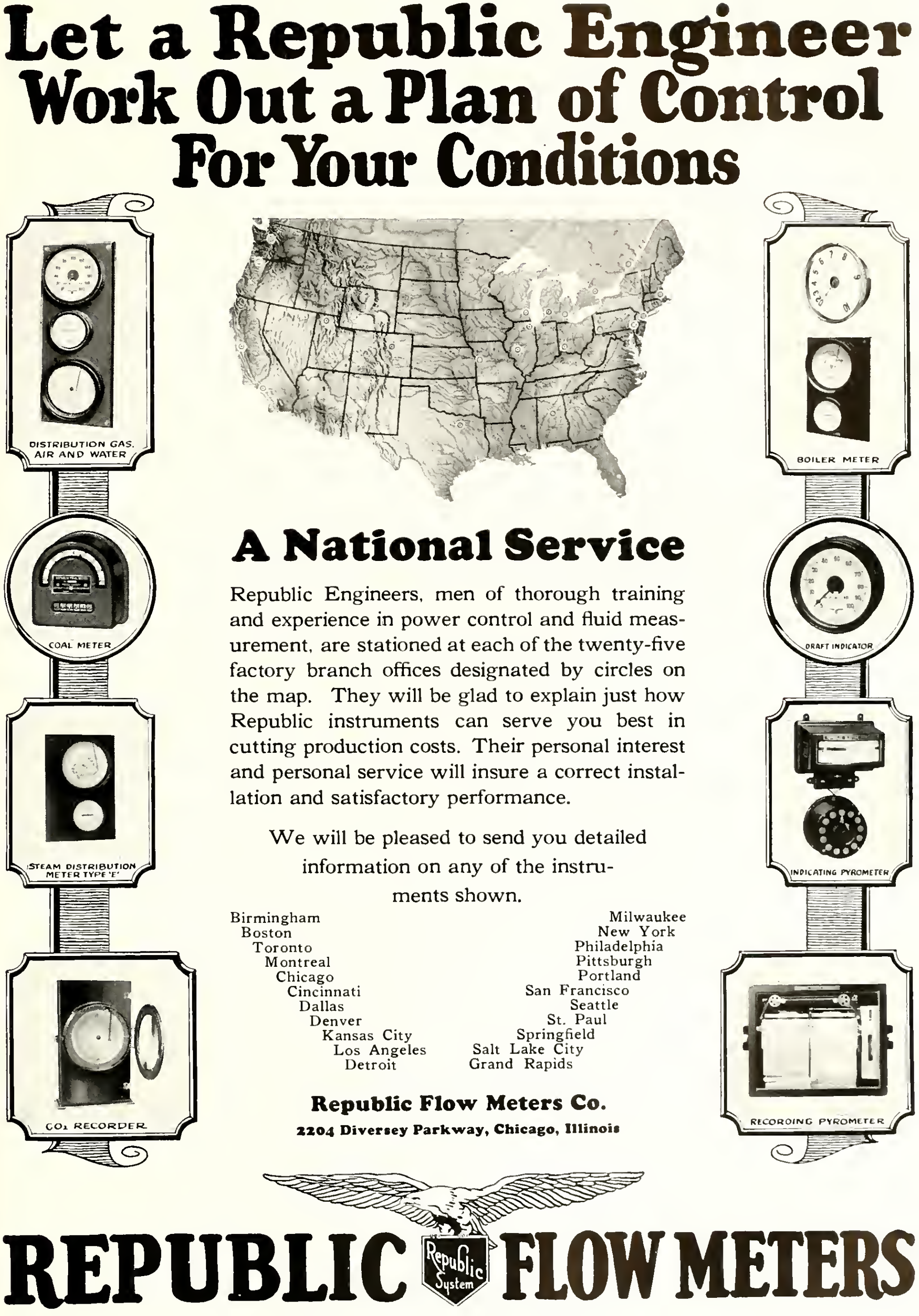
In preparing the specifications for this work, the Bureau of Design made an exhaustive investigation into the best of modern practice in construction. Realizing the absolute necessity for flawless concrete, the designers took extraordinary precautions to secure its uniform composition and density.

The improvement will cost about twenty-five million dollars, approximately half of which will go for construction work and the rest for the purchase of condemned property. According to the present schedule, excavation on the last section, that between State and Dearborn Streets, will start in May, 1926. The completed work will be ready for the public early in 1927, provided no new difficulties are encountered.

Ethyl Gas Found Harmless

Tests by the Bureau of Mines and others have demonstrated that the exhaust fumes from ethyl gas are harmless. The Bureau calls attention to the distinction between ethyl gas and tetra ethyl lead.

National Petroleum News.



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Republic Engineers, men of thorough training and experience in power control and fluid measurement, are stationed at each of the twenty-five factory branch offices designated by circles on the map. They will be glad to explain just how Republic instruments can serve you best in cutting production costs. Their personal interest and personal service will insure a correct installation and satisfactory performance.

We will be pleased to send you detailed information on any of the instruments shown.

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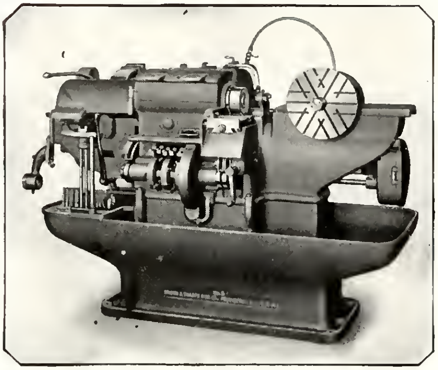
REPUBLIC FLOW METERS

Why interchangeable parts can be made at low cost—



BROWN & SHARPE Automatic Screw Machines

are one of the big reasons

THE low cost of parts for automobiles, sewing machines, typewriters, etc., is due entirely to quantity production. Many of these parts are made from bar stock and Brown & Sharpe Automatic Screw Machines are often responsible for the fast rate of production secured.

These machines when once set-up and supplied with stock, work automatically and perform each operation with a high degree of accuracy.

BROWN & SHARPE MFG. CO.
PROVIDENCE, R. I., U.S.A.

INDUSTRIAL BUILDINGS SHOULD BE WELL LIGHTED.

From the employer's viewpoint, the big difference between men who work out of doors and those who perform tasks inside the building, is the factor of light. Daylight furnishes sufficient illumination outside during the daytime working hours for men to pursue their tasks efficiently and safely. But the proposition of getting enough daylight into the interior of industrial buildings, requires some thought.

It is not a difficult problem by any means, and any employer can take advantage of daylight and utilize it for lighting his building during the daytime, if he desires. It is an excellent light, especially suitable for the eyes, reducing eye strain and eye weariness to a minimum, and has the great economic advantage of costing nothing.

To utilize daylight to the utmost, we must first provide means for allowing daylight rays to enter the interior of buildings in sufficient quantity—namely, proper and adequate windows and skylights. Many excellent instances of buildings designed with a due regard to the importance of daylight lighting can now be seen in many of our industrial cities. Such buildings present the appearance of being practically all windows—"window walled," as they are termed—and this type of daylight construction is coming rapidly into favor, because it constitutes a more healthy building for large numbers of employes, both from the lighting and ventilation standpoints.

Among those who have constructed this type of modern industrial building may be mentioned: The Shredded Wheat Co., Gillette Safety Razor Co., Lyon & Healy Piano Co., H. J. Heinz Co., Corona Typewriter Co., Skinners Macaroni Co., Grape Juice Co., Dodge Bros., Nelson Valve Co., Piston Ring Co., Remington Arms Co., and a great many others.

The Larkin Co., Philadelphia, has erected a building almost entirely glass, 85% being windows, and the Loomis Breaker, operated by the D. L. & W. R. R. Co., Nanticoke, Pa., is literally a glass house, being 93.5% of glass. The new buildings of the Winchester Repeating Arms Co. have an average glass area of 58%.

An investigation covering 18 buildings constructed by the Aberthaw Const. Co., Boston, shows that the average window area is 57.5%.

These figures indicate how important the subject of lighting is now considered by employers of industrial labor, and how well the idea has been carried out by the architects and engineers, in order that all parts of a building may receive sufficient daylight. But, in addition to providing ample window space, there is another factor which is equally important, and that is, equipping the windows with the proper glass.

The bright direct rays of the sun should not be permitted to strike the eye, and we must provide a means for reducing the glare to rays which will not be too bright. This is accomplished by glass especially manufactured for industrial windows, known as Factrolite. This glass possesses the property of breaking up the intense rays of the sun and diffusing the light into the interior of the building in proper portions, solving the problem of sun glare.

If you are interested in the distribution of light through Factrolite, we will send you a copy of Laboratory Report—"Factrolited."

MISSISSIPPI WIRE GLASS CO.,
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The ARMOUR ENGINEER

Vol. XVI MAY 1925

Published Quarterly by the College of Engineering,
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KOEHRING

Paving in Peru

IT is not only in this country that Koehring pioneers, but in sections all over the world the Koehring paver is blazing new concrete trails of progress, development and civilization.

In Peru, for instance—paving streets of Lima and thirty-two of its other principal cities, building the important motor highway between Lima and Callao and pushing paving work in Cuzco, Arequippa and Ayacucho. The Koehring paver is found taking its part in this major public improvement.

Koehring Pavers and Mixers are identified with noteworthy construction projects in all parts of the country and the world. "Koehring Heavy Duty" is a symbol signifying equipment of the highest grade, built to deliver maximum operating service over a period of years.

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The Armour Engineer

PUBLISHED BY THE COLLEGE OF ENGINEERING

Armour Institute of Technology

VOLUME XVI MAY, 1925 NUMBER 4

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that our advertisers will gladly furnish upon request

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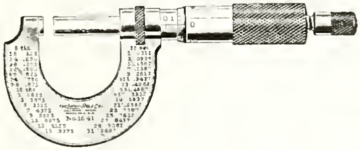

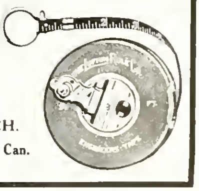

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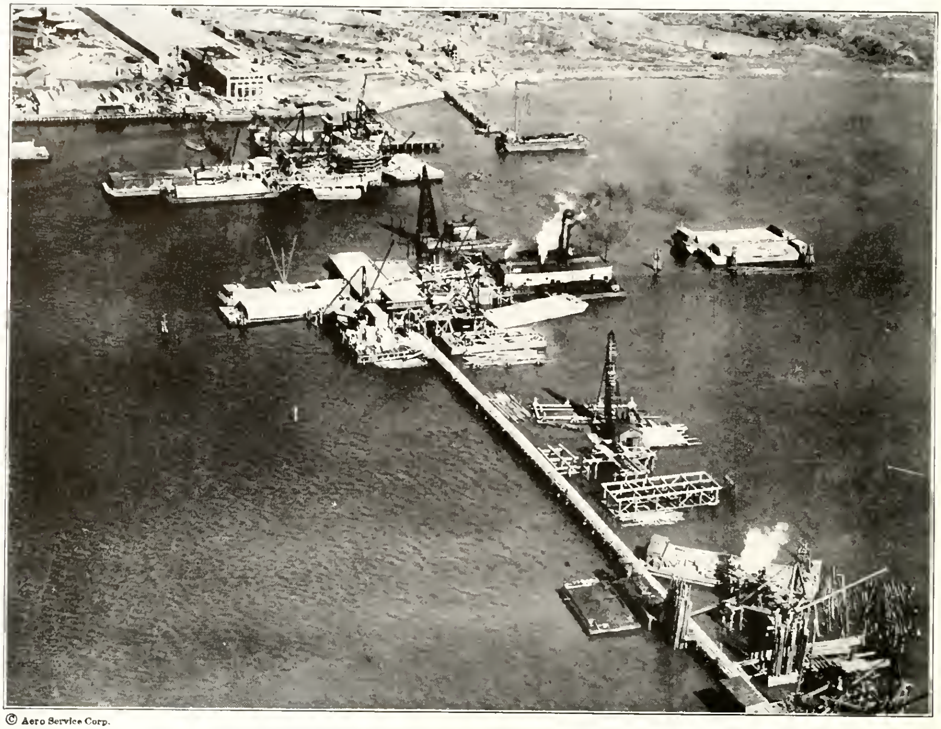

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Airplane View of "Victory" Bridge, Perth Amboy, N. J. *Channel Piers Built by the Foundation Company*

HIGHWAY TRAFFIC, WHICH IS NOW TREMENDOUS, AND WHICH IN THE YEARS TO COME WILL CONTINUALLY INCREASE, REQUIRES THE MOST MODERN BRIDGE STRUCTURES. FIRM FOOTINGS FOR THE CHANNEL PIERS OF THE $4,000,000 HIGHWAY BRIDGE, WERE OBTAINED, UNDER THE TREACHEROUS BED OF THE RARITAN RIVER, BY THE USE OF PNEUMATIC CAISSONS SUNK TO UNUSUAL DEPTHS.

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THE
ARMOUR ENGINEER

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THE FIFTY-FOOT INTERFEROMETER TELESCOPE

of the

MOUNT WILSON OBSERVATORY

By

F. G. PEASE, '01

ONE of the first things that astronomers attempted to do in the very earliest days of the telescope was to measure the diameters of the stars. As even today, with our powerful instruments, the angular diameter of a star is too small to be determined by direct micrometer measurement of the image at the focus of any telescope, they soon found that this was an impossible task. The problem soon appeared even more hopeless because before long they learned to determine the distances of the stars, which were found to be so enormous as to be measured only in terms of the distance that light travels in a year.

In 1868 Fizeau suggested that interference methods, described below, would provide a more powerful means than the micrometer of measuring small angles. In 1873 Stephan applied this method at the Marseilles Observatory and found that telescopes very much larger than his 31.5-inch instrument would be required to measure the diameters of the stars he examined. In 1890 Michelson pointed out that large apertures were not really necessary for the purpose, but that the result could be obtained by the use of a periscopic system described below, composed of four small mirrors which collect light from two pencils any distance apart and pass it through a telescope of small aperture. In 1920 one of these interferometers was built from plans of Michelson and Pease and attached to the 100-inch Hooker reflector. About this same time the first real clue to the diameter of a star was discovered in an indirect manner by Russell and Eddington through a comparative study of the absolute magnitude and surface brightness of the sun and stars. The hypothetical diameters they found for certain stars were very much greater than had been thought possible. Upon applying the interferometer to the measurement of these supposedly large stars the writer met with great success in the actual determination of their diameters.

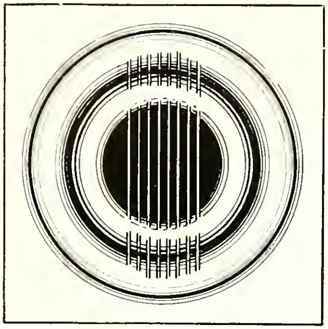


Figure 1.

The circular portions represent the usual telescopic image. The bands indicate the interference fringes.

Briefly, the principle of the interferometer as applied to the telescope consists in the bringing together at the focus of the telescope two pencils of light from the star. Here the customary diffraction image will be seen (Figure 1), and, in addition, a series of superposed dark and light bands called "fringes." If the star be sufficiently small, it will act as a point source and the fringes will be very conspicuous. If, however, the angular diameter is appreciable, each point acts as a separate source, resulting in an overlapping of fringe systems with consequent dimming of the pattern. It can be shown mathematically that the fringes disappear when we have the relation $\alpha = 1.22 \lambda/D$ where α, is the angular diameter in radians, λ, the wave-length of light—a value approximately 5.75×10^{-5} centimeters, and D, the separation of the pencils.

The "double star" interferometer, so called because it is used principally in measuring the separation of the components of double stars, consists of a plate having two apertures, which is placed in the converging beam of the telescope about two feet inside the focus. These apertures correspond to openings 7 by 11 inches projected on the large 100-inch mirror whose separation can be varied from 4 to 8 feet.

The "twenty-foot" interferometer, a diagram of which is shown in Figure 2, is a periscopic device for obtaining pencils of light from the star separated by an amount greater than the diameter of the mirror. On a steel beam are fixed two plane mirrors, 45 inches apart, inclined at 45° to the axis of the telescope, and facing downward and away from the axis of the large mirror. The other mirrors, variable in separation from 7 to 20 feet, are also mounted at an inclination of 45°, but upward and toward the axis. The 100-inch mirror is covered, except for the two openings underneath the inner mirrors and two additional openings, used for comparison purposes. Since the paths of the two pencils of light must have the same optical length, various equalizing devices are used to compensate for any differences arising from flexure, etc. The images formed by the two pencils are brought to a common point at the focus of the telescope through small adjustments by means of motors. The image of the star first shows only the usual central bright disk surrounded by diffraction rings and it is necessary to make adjustments for path differences before the fringes appear as a series of alternately dark and bright bands superposed on the star image. When the outer mirrors are moved apart, the fringes for certain stars fade away; if the mirror separation corresponding to disappearance of the fringes be measured and found equal to D, the angular diameter of the star may be obtained by the equation given above. The linear diameter is then determined from the known distance of the star.

Stellar Distances and Diameters

Star	Angular Diameter Seconds of Arc	Distance Light Years	Linear Diameter Miles
Antares—α Scorpii	0.040	383	430,000,000
Orbit of Mars	....	...	282,000,000
Mira—ο Ceti	0.056	163	260,000,000
Betelgeuse—α Orionis	0.047	163	218,000,000
Orbit of Earth	....	...	186,000,000
Scheat—β Pegasi	0.021	251	150,000,000
Aldebaran—α Tauri	0.020	53	30,000,000
Arcturus—α Bootis	0.020	34	20,000,000
Sun	1922.4	0.000016	866,000
Earth	....	...	8,000

One Light Year = 5.89×10^{12} miles.

The accompanying table gives the measured angular diameters, the distances in light years obtained from parallax measures, and the deduced linear diameters of a number of stars, to which are added a few well known astronomical distances for comparison.

So successful were the measures obtained with these two interferometers that the construction of a 50-foot interferometer telescope from plans of Hale and Pease is now in progress in the observatory shops. Since it is out of the question to attach an interferometer of this size to the 100-inch telescope, it is being built as an entirely separate instrument and will be mounted in a housing of its own.

The interferometer, a model of which is shown in Figure 3, consists of a structural steel frame *a*, called the "bridge," mounted cantilever fashion on the north end of a short axis *b*, shown in Figure 4, supported on the steel pedestal *c*, and driven by the clock *d* (see Figure 6) through the worm and worm wheel *e* and *f*. The optical parts consist of two movable plane mirrors *1* and *2*, two fixed plane mirrors *3* and *4*, a concave mirror *5*, a small plane mirror *6*, the compensator *7*, and the eyepiece *8*. The movable mirrors are mounted on carriages which travel simultaneously toward or away from the center of the beam, the separation varying from 6 to 50 feet. These carriages move on tracks accurately machined and adjusted to a true plane. They are driven by means of two screws accurately cut and ground, both of which are operated by a single motor. In addition to their longitudinal motions these mirrors rotate about a common horizontal axis passing through their centers and lying parallel to their longitudinal motion, thus enabling the observer to set the mirrors for stars of different declinations. If it is found that the displacements of the images at the focus due to flexure of the frame are larger than is desirable, a double mirror system similar to that used in some types of range finders will be substituted. The greatest difficulty in maintaining optical perfection in the figures of astronomical mirrors arises from distortion caused by changing temperature. As the mirrors of this interferometer stand in the open, they are subject to this change. To prevent as much as possible their distortion, they are made of pyrex glass, which has a much lower temperature coefficient than ordinary glass.

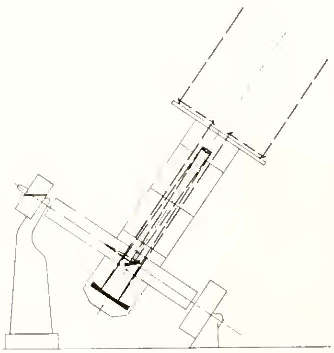


Figure 2.

Diagram of the path of the two pencils of light in the twenty-foot interferometer.

The fixed mirrors are mounted at angles of 45°, their faces receiving the light from the movable mirrors and sending it downward to the concave mirror. Their centers stand 29 inches apart, the outer edges of their faces lying within a circle 40 inches in diameter. Each of the fixed mirrors is provided with two fine motions, which enable the observer to superpose the two images after they have been brought approximately into position by the outer mirrors.

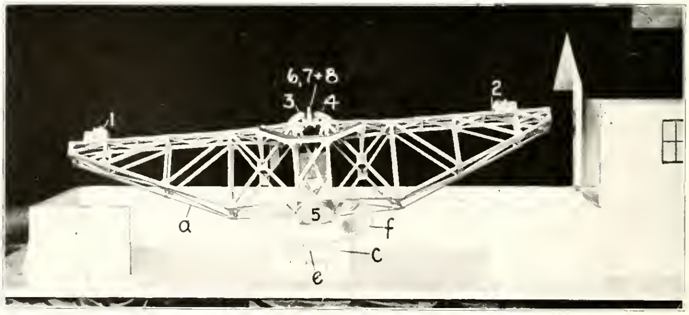


Figure 3.

Model of fifty-foot interferometer telescope—looking south.

The west mirror has also a micrometer slow motion along the bridge to compensate for differential expan-

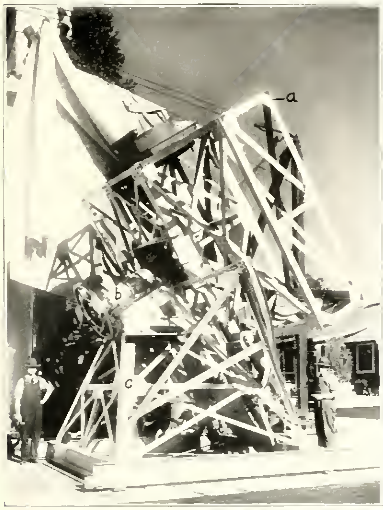


Figure 4.
Fifty-foot interferometer telescope under construction—looking west.

sions in the bridge and for variations in the atmospheric paths through which the light travels. As described later this compensation can be made at the eyepiece, but usually the eyepiece compensation serves to indicate the amount of correction to be made by adjusting the west mirror. All four mirrors are alike, 15 inches in diameter and 2½ inches thick.

The image-forming part of the optical system is a concave mirror of 40-inch aperture and 18-foot focal length. It is placed at the bottom of the central panel of the bridge in a cast iron cell, which permits proper adjustment. Since the mirror is well protected in its cell by an insulating wall of cork board, it is made of the usual "plate glass" composition manufactured by the St. Gobain Glass Works in France. As the glass disk has a thickness of only 5 inches, it is necessary to support it on a system of plates which distributes the load equally on each support. Three of the plates are fixed to define the plane of the mirror, while the remainder, with levers and counterweights, support the weight of their corresponding segments. The edge of the mirror rests on its lower side on two concave cylindrical pads, a third pad being added at the top to prevent any displacement as it turns into positions east and west of the meridian. Thus far the light from the star has been traveling as a beam of parallel light; at the mirror a curvature is imparted to the wavefront so that the beam converges to a point 18 feet from the mirror. It passes from the concave mirror to an inverted 45° mirror lying between the two fixed mirrors and thence to the compensator and eyepiece, which are in a position convenient for observation from the north side of the bridge. All these parts are fastened to the bridge and move as a unit with it, the observer operating from a fixed platform built above the polar axis.

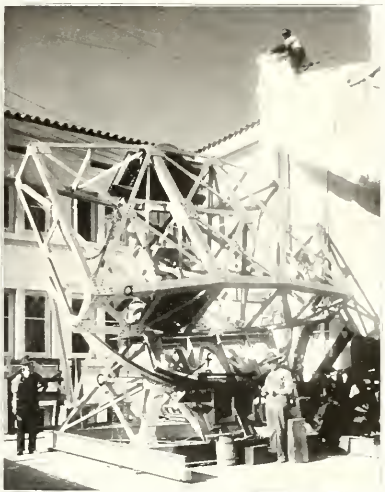


Figure 5.
Another view of the fifty-foot interferometer telescope under construction.

The function of the compensator is to equalize the two paths of light from the star so that they are "optically" equal. Beams of light leaving the star and traveling over two separate paths must arrive at the same instant, otherwise there will not be any fringes. Two separate pulses from the star cannot interfere; this phenomenon holds only for parts of the same optical beam. Many things can cause a difference in path, for example, slight variations in the density of the atmosphere, relative expansions of different portions of the interferometer frame, or a slight displacement of the star images from the crosswires in the eyepiece. To correct this, advantage is taken of the different speeds of light in traversing air and glass. In one pencil is placed a plane parallel piece of glass, and in the other a similar piece, except that it is composed of two wedges of glass which can be displaced with respect to one another so as to make the plate either thicker or thinner. Since it is best to work the instrument without too much compensation, two pencils are taken directly from the concave mirror from stars very close to the equator, the reading of the wedge shift is taken, and correction made by moving the west fixed mirror the proper amount. For the comparison or zero-distance fringes, an artificial source having the customary pin hole and two slots is used. One of the slots is variable in width and the variability is read off on a scale calibrated to read directly.

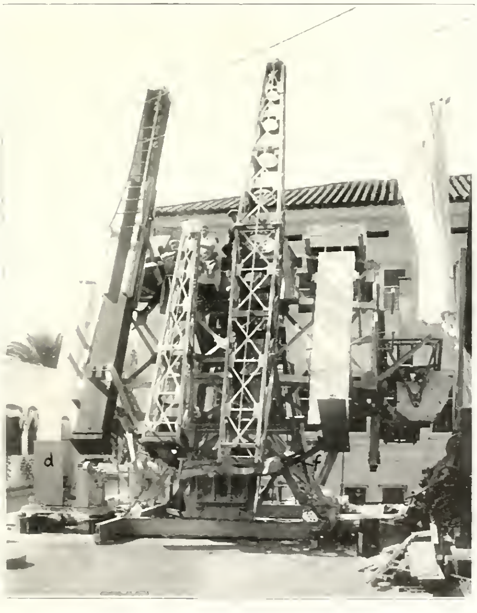


Figure 6.
North side of fifty-foot interferometer telescope, showing eclipse cameras.

The bridge is a latticed steel frame 54 feet 5½ inches long and is composed of five sections as follows. The central panel is 4 feet

6 inches long, 4 feet 9½ inches wide, and 10 feet 4 inches deep. The adjoining panels on either side are 6 feet 10 inches long, 4 feet 9½ inches wide at the inner end and 2 feet 10 inchs wide at the outer end, and 10 feet 4 inches deep. The end sections are 18 feet ¾ inch long, 2 feet 10 inches wide, and 10 feet 4 inches deep at the inner end, and 1 foot 9¾ inches at the outer end. The structural members are all angles and vary in size from 6×6×⅜ inches to 3×3×¼ inches. The gusset plates are ⅜ and ½ of an inch thick and the whole structure is put together with ¾-inch turned bolts in reamed holes. The estimated weight of the bridge itself is 7,300 pounds and the total load on the axis, including mirror mountings, etc., is 14,000 pounds.

To the south side of the bridge is bolted a steel casting 58 inches long and 35¼ inches wide with ribs 6½ inches deep, with additional bolting flanges. This is faced and bored to receive a shoulder of the polar axis. The casting is so placed as to bring the line of the polar axis through the center of gravity of the assembled bridge, which reduces the eccentric loading on the driving mechanism. The polar axis is of 0.50 carbon steel, with an elastic limit of 80,000 pounds per square inch, forged and heat treated and so drawn as to be machined with difficulty. Its flange is 24½ inches in diameter and 2½ inches thick and is thinned to 1½ inches thick to form a shoulder fitting into the steel casting. It is rounded off so as to join the upper cylindrical bearing having a diameter of 7.874 inches and then tapers to about 4½ inches in diameter where the section is somewhat stepped to receive the various thrust and radial loads. It is 4 feet 6 3/16 inches over all. Each bearing is composed of two S K F annular bearings, whose carrying capacity is far in excess of any loading thus far contemplated, a practice which gives long life and the fine running qualities needed in such instruments. The north bearings are S K F No. 1140, 12.2047 inches outside diameter; the south bearings S K F No. 1317, 7.0866 inches outside diameter; and a single thrust bearing at the south, S K F No. 514, about 6¼ inches outside diameter. The polar head carrying these bearings is an iron casting, in the shape of a ribbed conical tube 3 feet 1½ inches long, bearing four lugs with which the instrument is fastened to the pedestal and in which adjusting screws are fitted, so that the axis can either be adjusted vertically, tipped longitudinally, or rotated sideways—motions which are necessary to align the axis properly with respect to the auxiliary roller tracks. The polar head is carried on a large pyramidal base, the top of which is truncated at an angle of 34°. It is formed principally of four 6×6×⅜ inch angle struts bearing on 12-inch, 31.5-pound **I**-beams and tied with smaller angles. The top inclined surface of the pedestal is 28 inches by 39 inches, the foot of the struts, 10 feet 6 inches by 12 feet, while the four adjusting screws on the **I**-beams form a rectangle 12 feet 4 inches east and west by 12 feet 1 inch north and south. A ribbed plate is fastened to the top surface to carry the polar head screws. To guide the bridge and prevent its vibration, two rollers, 9 inches in diameter, with spring cylinders for cushioning, are fastened to the bridge and travel on a circular track fastened to the north face of the pedestal. The track, a 5-inch, 9.75-pound **I**-beam, has a radius of 8½ feet and is very carefully machined to a true plane surface.

On March 8 it was announced at the Carnegie Institution of Washington that measurements had just been completed at the Mount Wilson Observatory of the diameter of the star Mira. The success attending the observations upon Mira is the latest triumph of Mr. Pease, the astronomer at Mount Wilson, who has, since 1920, measured the five largest known stars in the universe. Betelgeuse, Arcturus, Aldebaran, Scheat, which is Beta of Pegasus, and the fiery Antares are the other "points of light" which have yielded to the measuring-stick of Mr. Pease.

Mira is the second largest star known, being surpassed, as far as our knowledge goes, by Antares alone. The diameter of Mira is so vast that, were the sun placed at its center, the star could comfortably contain the orbit of the earth. But the distance of Mira is so great that it never appears brighter than a star of the second magnitude. The angle subtended by the star, to use an illustration given by Science Service, is the same as that of the head of an ordinary pin five miles away. The name Mira, meaning "the wonderful," was given to the star by ancient astronomers on account of its periodical variations in brilliance. The reason for this variation was established about a year ago when it was discovered that Mira is a double star.

The worm sector is a large iron casting bolted to the bottom and north sides of the bridge and is very carefully located with respect to the axis since the whole instrument has to be dismantled for transportation. After bolting and doweling it to the bridge it was then machined, hobbed, and ground in position, the axis itself being used as a center. The sector is a little over 60° and permits a travel of two hours either side of the meridian. The worm and sector are of the same dimension as those of the 100-inch reflector, the same cutters, hobs and grinding worms being used. The pitch is 0.4375 circular p., left-hand single. There are 1440 teeth to the circumference of the wheel, its pitch radius being 100.2671 inches.

The worm is mounted on a sliding table which permits all adjustments necessary to insure the proper meshing of the worm and sector. It is 4½ inches pitch diameter with 8 inches of thread. It is mounted on two S K F self-aligning bearings, No. 1211, placed 34 inches apart, and the thrust is a double S K F No. 709. The worm dips continually into a bath of clock oil which is freed particularly from acids and from gumming properties.

The driving clock stands a few feet to the east of the pedestal and transmits power to the worm through a control gear-box. The clock is patterned after the type developed by Warner and Swasey, which we have found from long experience with the 100-inch and 60-inch reflectors to give the very finest kind of motion. Almost the only variation introduced is the substitution of S K F ball bearings throughout to replace the earlier slightly barrel-shaped spindle bearings. This reduces the driving weight to a third or a quarter of that previously used.

The gear-box permits the rapid setting of the instrument in right ascension and a delicate control while the instrument is following the star. Double Hooke's joints connect the clock to the gear-box and the gear-box to the worm to permit ease of alignment and the elimination of periodic error due to lack of it.

The central section of the bridge and the complete driving mechanism were employed in 1923 as the common carrier for the various cameras and spectrographs used at the eclipse. Figure 3 shows a model of the instrument with its movable shed; Figures 4 and 5, the instrument under construction; and Figure 6 shows the telescope with all the eclipse cameras attached.

THE WORK OF THE FOREST PRODUCTS LABORATORY

By

F. J. CHAMPION

United States Forest Products Laboratory

THE Forest Products Laboratory of Madison, Wisconsin, is a part of the research branch of the United States Forest Service. This laboratory—the first of its kind to be established—was started in 1910 for the study of the physical and mechanical properties of wood, its chemistry and pathology, and its manufacture, conversion, and use. The purpose behind the accumulation of knowledge resulting from these studies is the same as the whole purpose of the Forest Service, namely, the maintaining—by growth or conservation—of an adequate timber supply.

Although the laboratory is housed in a building of the University of Wisconsin and is given an allotment of light, heat, and power, it is administered solely by the United States Forest Service and not as a university department.

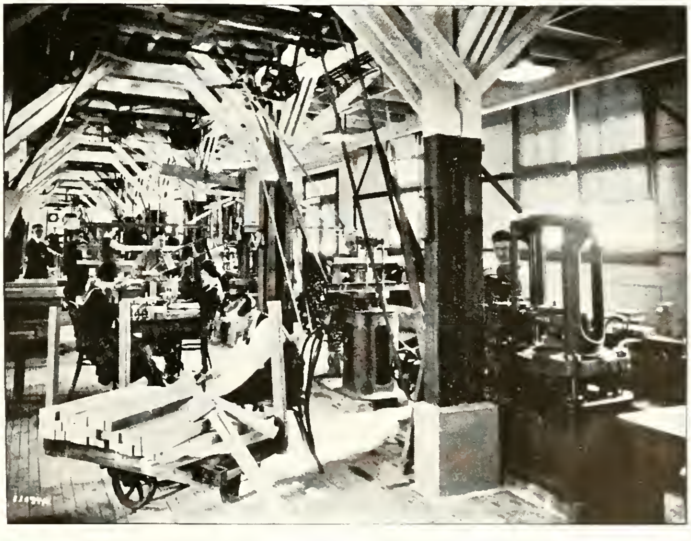
Naturally, because of the complexity of wood and because of its myriad uses the Forest Products Laboratory is divided into a number of investigative sections specializing on separate phases of the general problem. As the mechanical properties of wood are probably those of the most direct interest to the majority of users, the largest section of the laboratory is given over to studies of the mechanical properties of the commonly used species. When it is realized that more than one-half of the timber cut each year is for use in building, the scope of economies possible through accurate knowledge of the mechanical properties of the woods used for structural purposes may be appreciated.

An example of strength study which is of considerable interest to the forester is the investigation now in progress regarding the influence of growth conditions on the strength properties of wood. There is a wide spread opinion among lumbermen that the locality of growth has an important bearing upon the properties of wood. To test the soundness of this opinion, samples of the species under investigation are collected from various parts of the country and from stands representing the various site conditions in each region, and careful comparisons of strength, growth rate, and specific gravity are made. Results of investigations already completed show that for a species studied, favorable or unfavorable growing conditions on the immediate site are of far greater influence on strength than geographical location alone.

Mr. F. J. Champion.

To carry on its tests of the mechanical properties of wood the Forest Products Laboratory is well equipped with testing apparatus. This ranges in capacity from a machine which tests the toughness of specimens a half-inch square, through a series of universal machines capable of applying a maximum load of a few hundred thousand pounds to a million-pound machine which can cause the failure of wooden columns a foot square.

The wood preservation section is organized to develop preservatives, wood treating methods, and sanitary measures to cut down the largest single item of preventable waste that occurs in timber production and use; that is, the destruction of wood by decay. Besides an equipment of tanks for various steeping treatments this unit of the laboratory is provided with several pressure treating cylinders for impregnating wood so as to obtain deep penetration with creosote, zinc chloride, or other preservatives. A large part of the work of the section of wood preservation is performed on railroad ties because these are convenient to work with and give results of general application. Sections of test tracks are maintained throughout the country where treated



Interior view of the timber testing laboratory.

and untreated ties are under observation under various service conditions. Carefully kept records are on file for nearly a million ties. Test installations and service records are also maintained for posts, poles, mine and structural timbers, paving blocks, and marine piling. The protection of water-front piling against the attack of marine boring organisms is a problem far more difficult of solution than ordinary protection from rots.

In addition to its studies of the effects of various preservatives in protecting wood from the gross effects of decay, the laboratory carries on biological studies of decay organisms in cooperation with the Bureau of Plant Industry. Particular attention is paid to the fungi which stain or rot lumber. The relative destructiveness of different fungi is determined and the action of various chemicals on laboratory cultures of the organisms is investigated before any large-scale trial impregnations with chemicals of uncertain effect are attempted.

The kiln drying of wood continues today, as it always has, to entail considerable degrade of lumber with resulting waste and financial loss. The solution of the kiln drying problem as seen by the Forest Products Laboratory involves first, absolute means of controlling temperature and humidity conditions in all parts of the kiln throughout the drying; second, a knowledge of the moisture changes and the stresses set up in wood during drying; and, third, the perfecting of means of measuring these stresses at any time and relieving them through steaming or through the use of high humidities. The laboratory has found that drying degrade can be considerably reduced even with fast drying schedules. For southern pine, for instance, research has devised 72-hour kiln drying schedules which have reduced degrade from about 20 per cent to 5 per cent in the upper grades and from about 30 per cent to 10 per cent or less in the common grades.

The kiln drying section has developed a reversible circulation internal fan kiln, by which great rapidity of air movement is obtained and, because of the reversible feature, uniformity of drying in all parts of the piled lumber.

The equipment of the section includes a battery of full sized kilns remarkable for their flexibility of control, and a set of small drying chambers. In addition to kiln studies, an exhaustive study of air seasoning problems is also in progress.

Although most of the work of the laboratory is of practical application and takes account of the requirements of the various wood industries, one section has been created whose particular sphere is industrial investigations. This section studies the methods and requirements of lumber manufacturing and woodworking establishments to the end of introducing timber conservation in marketing and manufacturing methods. Studies in the woods to determine the factors which lead to incomplete utilization and the extent to which it is possible to utilize the logs and tops completely also come within the sphere of this section. Some of its important projects are the working out of the technical problems connected with national standardization of grades and dimensions for yard and factory lumber, the utilization of ready-cut small dimension stock from present woods and mill waste in the production of manufactured articles, more adequate outlets for the now barely marketable short and odd lengths of lumber, and the use of "inferior" species. The maintenance of a clearing house of information for those having sawmill and factory waste to dispose of and for those who can utilize such waste as raw material for their products is one of the practical activities of this section as well as assistance given to industries as to methods of utilizing waste through the manufacture of side lines such as wood flour, sweeping compounds, etc.

In cooperation with the Department of Commerce and the National Lumber Manufacturers' Association the Section of Industrial Investigations has brought the standardization of softwood yard lumber up to such a point that it has received consideration by the general lumber trade in the making up of American standards for yard lumber. Preparations for the standardization of softwood and hardwood factory lumber are well under way.

The derivation of chemical products from wood is extremely important because of the importance of the substances which we have thus far been able to obtain economically from no other source, and because of the possibilities of waste utilization in this field. One section of the laboratory is engaged in the study of the fundamental chemistry of wood, and in the improvement of processes for the production of valuable chemical products. Significant progress, for instance, has been made in developing efficient processes for converting sawdust and wood waste into ethyl alcohol. Investigations of the value of hydrolized sawdust as a stock food have been under way for several years, and it is not yet certain that this product may not have some value. Modifications in the process of distilling wood alcohol from hardwoods have led to an increase of 50 per cent of the product from a given quantity of wood.

The section of pulp and paper investigations is at present one of the largest and most active of the divisions of the Forest Products Laboratory, owing

(Continued on page 152)

Practically all of the wood received at the Forest Products Laboratory for experimental purposes arrives in log form. This log yard has probably had stored in it from time to time more species of wood than any other log yard in the world.

TRANSMITTING EQUIPMENT
FOR RADIO TELEPHONE BROADCASTING

PART II

THE 101-B RADIO BROADCASTING EQUIPMENT

By

EDWARD L. NELSON, '14

Electrical Engineer, the Western Electric Company

HAVING discussed various aspects of the general design problem, a brief description of a commercial system of the type which has found application in some forty of the larger broadcasting stations in the country may be of interest.

The transmitter in its housing is no doubt already a familiar object since it has appeared with great frequency in published photographs of broadcasting activities. An idea of the arrangement in more detail, however, may be obtained from Figure 1. On the left is shown the housing with the cover removed. The transmitter is supported by means of a series of coiled springs to reduce noise effects due to mechanical vibration. A 12-foot flexible cord is ordinarily provided which terminates in a standard three-wire attachment cap. When in service, the latter is inserted in a suitable receptacle, usually mounted on the base board in the studio.

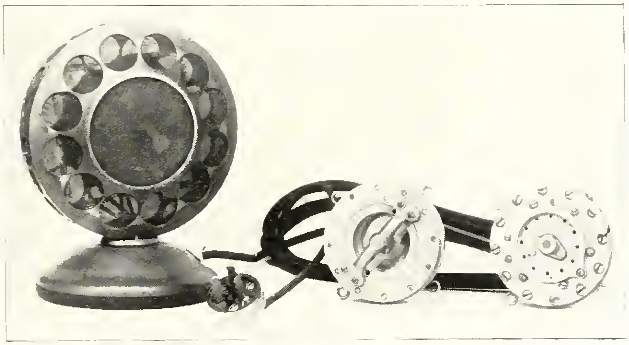


Figure 1. © *Western Electric Co.*

The microphone which is the beginning of broadcasting. It uses two carbon buttons, connected in "push-pull."

The appearance of the transmitter itself from the rear, and from the front, respectively, is shown by the two views on the right. A light, thin diaphragm is employed which is securely clamped between the two heavy exterior rings. An interior ring stresses the diaphragm like a drum head so that its natural frequency is brought above the range which it is desired to transmit. In this manner "blasting" effects due to diaphragm resonance are practically eliminated. Its performance in this respect is still further improved by the application of air damping. A perforated metal plate is mounted close to the diaphragm in the rear, providing a thin film of air which serves to increase the damping and bring about a much flatter frequency characteristic. Two carbon buttons are employed, one on each side of the diaphragm. One of these is mounted in the center of the damping plate; the other is supported by means of a heavy bridge secured to the clamping rings. It will be noted that with this arrangement, as the diaphragm vibrates, the pressure on one button is released when that on the other is increased. For this reason, it is sometimes referred to as the "push-pull" type. These various improvements have resulted in a transmitter which permits of a reproduction of speech and music not greatly different from the original. As has been previously mentioned, however, the efficiency of such an instrument is considerably lower than that of the substation type and two or three stages of amplification are required to attain ordinary telephone volume levels.

The vibratory system of the condenser transmitter is similar in construction to that of the carbon unit. The buttons and bridge are omitted, however, and the rear damping plate is carefully insulated to serve as the second armature of the condenser. The capacity of the condenser thus formed is approximately 400 micro-microfarads and the variation brought about by the vibration of the diaphragm is of the order of one hundredth of one per cent. As has been stated, this device is considerably less efficient than the carbon transmitter and requires an additional two-stage amplifier if equal volume is to be obtained. It is also subject to several other more or less serious limitations. On account of its low capacity and correspondingly high impedance, a relatively short cable of low electrostatic capacity must be employed to connect with the initial stage of the amplifier if serious transmission losses are not to be experienced. Also, its high impedance results in the amplifier being operated with the input of the first amplifier tube practically on open circuit and the latter becomes extremely sensitive to inductive disturbances which introduce noise into the circuit. The fact that four or five stages of amplification are required to attain ordinary telephone volume levels is in itself a serious disadvantage from a noise point of view, since under these conditions the problem of adequately controlling tube noises, variable leakage paths, battery voltage irregularities, etc., becomes extremely difficult. On the other hand, the condenser transmitter is the most highly developed device of its kind now available and affords somewhat better transmission than the carbon instrument. Where the very best results are desired, therefore, irrespective of expense, it finds application.

A type of condenser transmitter equipment which has been designed primarily for studio use may be substituted for the carbon unit already described. The transmitter is mounted in a housing of the usual type and fitted with a special 6-foot low capacity cord. The amplifier unit takes the form of a cabinet of the phonograph type with the amplifier proper mounted in the upper portion on a horizontal panel. Adequate shielding is afforded by a metal backing on the panel and a removable metal cover attached thereto. Space is provided in the lower portion for a 6-volt storage battery for heating the filaments and a 200-volt dry battery for the transmitter and plate circuits. Provision is made for controlling the device from the radio room by means of a relay in the filament circuit operated by the current which would normally flow through the buttons of the carbon transmitter. Since the amplifier is fitted with an output cord similar to that used with the carbon transmitter, it may be plugged into the circuit interchangeably with the latter and employed without change in the operating procedure.

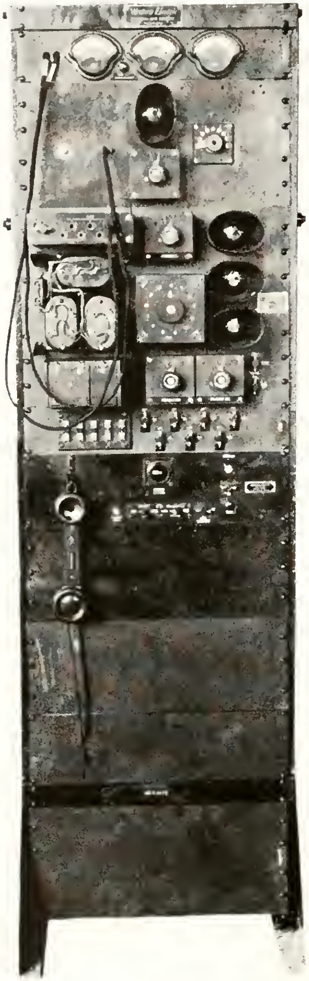


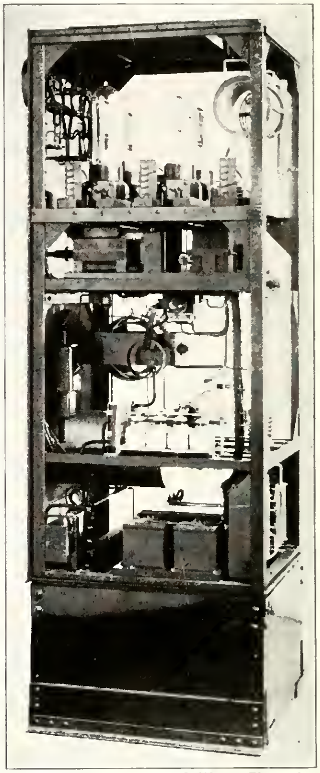
Figure 2. © *Western Electric Co.*

The speech input equipment. At the top of the speech amplifier panel are the filament and plate circuit meters; then the monitoring amplifier and the three-stage speech amplifier. Volume of speech frequency power is controlled principally by the multi-point switch in the center of the panel. The last panel is for the intercommunicating and signaling system.

The studio signaling and control unit is shown in the upper left-hand corner of the picture-schematic, Figure 4. As is evident, it takes the form of a wooden cabinet, similar in outline to the ordinary subscriber's set, having the necessary switches and signal lamps mounted on the front panel. The telephone hand set permits of direct communication with the operating room. The white lamp, key, and push button to be seen on the left and at the bottom of the panel are associated with a signaling buzzer circuit. The lamp at the right, which is green, is controlled from the operating room and serves to indicate to the studio director when the radio equipment is in operation and ready for the program to begin. The key immediately below it serves to control the studio transmitter circuit and, in addition, when thrown to the broadcast position, opens the circuit of the signaling buzzer and lights a lamp behind the large red bull's-eye at the top of the unit.

The speech input equipment is shown in Figure 2. As will be noted, this apparatus consists of five separate units: a meter panel, a three-stage amplifier, a switch and fuse panel, a signal and control panel, and a single-stage monitoring amplifier. Vacuum tubes having an amplification constant of approximately thirty are employed in the first two stages of the three-stage amplifier. The last stage employs a tube having a considerably lower amplification constant but a greater power capacity. Potentiometers in both the first and second stages afford a wide range in amplification control. Power for the filaments is obtained from a suitable 12-volt storage battery. A 130-volt battery consisting of standard No. 6 dry cells supplies power to the plate circuits. Grid voltages for the first two tubes are obtained by utilizing the voltage drop over suitable resistances in the filament circuit. A grid battery of the flashlight type is employed with the third tube. The maximum amplification to be had with this amplifier is 85 miles, representing a power ratio of 1.2×10^8. By means of the potentiometers, the amplification can be varied by 3-mile steps from the maximum down to approximately 25 miles.

The signal and control panel is employed in connection with the studio unit which has already been described. On this panel, in addition to the intercommunicating telephone circuit and the buzzer and lamp signaling facilities, arrangements are made for the control of the radio transmitter, the microphone circuits, and the monitoring circuits. The radio transmitter control feature takes the form of a key which operates a relay in the field circuit of the plate generator. In the microphone circuit, a suitable three-position, multipole key is provided enabling the studio transmitter, the operator's transmitter, or a third instrument (or a wire line) to be connected to the input terminals of the amplifier as the occasion may require. These two keys are electrically interlocked with the green "RADIO" lamp on the studio unit, so that both keys must be thrown in the proper direction before a signal is given to the announcer. For monitoring purposes, a suitable key is provided to connect the monitoring loud speaker to either a special vacuum tube rectifier which is built into the radio transmitter and coupled to the antenna circuit, or



© *Western Electric Co.*

Figure 3.

This shows the "works" of a 500 watt radio transmitter. At the rear of the top compartment are the twin oscillator tubes; in front of them are the twin modulator tubes. At the right is the antenna tuning coil and below, the last audio amplifier tube. In the third compartment are the closed tuning circuit and the monitoring detector tube.

the monitoring amplifier which is connected permanently to the output terminals of the three-stage amplifier. By the operation of this key it is possible, therefore, for the operator to listen either to the outgoing transmission or to the input to the radio transmitter and to keep an accurate check on the operation of the equipment. When the microphone control key is thrown to the operating room position, a red lamp on the panel is lighted and the monitoring loud speaker is disconnected, irrespective of the position of the monitoring key, to prevent "singing" between the operator's transmitter and the loud speaker. A white guard lamp is also provided on the panel to indicate to the operator when the studio control key is thrown to the broadcast position.

The monitoring amplifier is a single-stage unit of the usual type but with transformers designed for high quality transmission. A potentiometer is provided for volume control. A suitable loud speaker mounted on the operator's desk is associated with this amplifier for monitoring purposes.

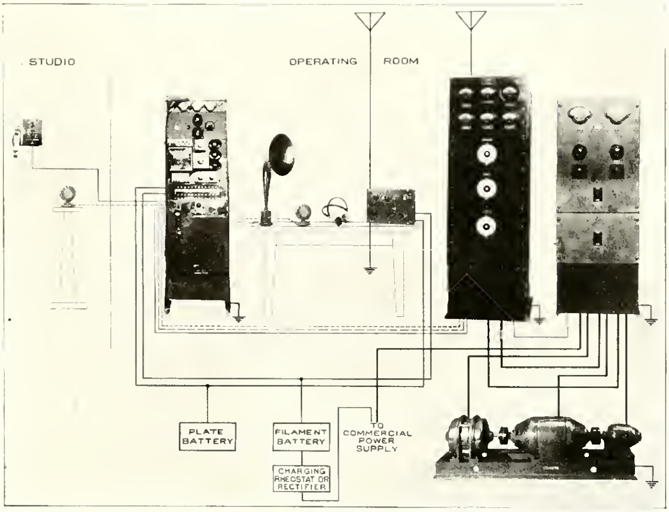


Figure 4. © *Western Electric Co.*

A picture-schematic of a Western Electric 500-watt broadcasting station. All of the units are shown and the various connections between them, the broadcasting circuits, the signal and control circuits, and the power circuits are indicated by the different types of lines. Viewed in combination with the detailed descriptions of the various units, this drawing will enable the general aspects of the system to be readily understood.

A rear view of the radio transmitter is shown in Figure 3. This unit is of the oscillator-modulator type employing two 250-watt tubes as oscillators and two similar tubes as modulators. One 50-watt tube is also utilized as a speech amplifier working into the modulator tubes. The oscillator circuit is of the Meissner type, that is, both the grid and plate circuits are inductively coupled to the oscillatory circuit, but it departs from the usual arrangement in that an adjustable condenser is employed in parallel with the plate coil. This variation has been shown to afford a simple and convenient means of adjusting impedance conditions in the circuit so as to bring about efficient operation. As will be noted, the oscillator does not work directly into the antenna, but a closed oscillatory circuit is employed which is coupled to the antenna circuit by means of a mutual capacity. This arrangement has been adopted primarily for the suppression of harmonics. The use of two tuned circuits and capacity coupling affords a high degree of discrimination against these higher frequencies and radiation is confined almost entirely to the desired frequency band. The use of coupled circuits also results in somewhat better frequency stability than that representative of a transmitter employing the antenna as a part of the oscillator circuit, but dependence in this respect must be placed primarily upon a rigid antenna structure.

Another feature of possible interest in connection with the radio frequency circuits is the antenna discharge resistor which may be seen in Figure 3 in the upper right-hand corner. Experience has indicated that with many antennae, if a series condenser is employed, this interrupting the direct current path to ground, static charges will accumulate which may build up to a voltage sufficient to break down the safety gap of the condenser. A number of stations have reported occasional interruptions arising from trouble of this nature. Observations to date indicate, however, that a relatively high resistance connected as shown is a complete solution of the problem.

The audio frequency portion of the transmitter circuit, embracing the speech amplifier and the modulator, is essentially a two-stage, audio frequency amplifier. The output circuit of the last stage of this amplifier (the modulator) includes the plate circuit of the oscillator. The power supply to the latter may be considered to consist, therefore, of a direct component upon which is superimposed an audio frequency component corresponding to the desired transmission. Under these conditions the output of the oscillator varies in proportion and the envelope of the time-antenna current curve is a faithful reproduction of the signal voltage impressed upon the plate circuit. It is interesting to note in this connection that, within the usual operating limits, the distortion which can be traced to the radio frequency portion of the transmitter is negligible. In other words, by suitable design of the radio frequency circuits, the matter of insuring high quality transmission may be resolved into proper treatment of the audio frequency circuits, and all of the accumulated experience of the telephone art brought to bear upon the problem.

A somewhat novel feature of the audio frequency circuit is the method employed for obtaining negative grid voltages for the speech amplifier and modulator tubes. A resistance is employed between the negative terminal of the plate generator and the filaments. The grid circuit is connected through a filtering network to such a point on this resistance that the *IR* drop due to the plate current represents the required negative grid voltage. This method has been shown to give satisfactory results in practice and renders a grid battery unnecessary, an important consideration from a maintenance point of view.

The mechanical features of the transmitter are clearly shown in Figure 3 and in the schematic and require little explanation. The meters and controls are centralized upon the front panel.

(Continued on page 151)

FIRE ALARM SYSTEMS

PART II

By

CHARLES A. WHITNEY

Engineer, The National Board of Fire Underwriters

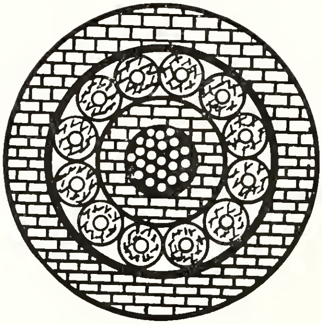
FIRE alarm circuits answer two purposes or perform two functions and these are required in both Class A and Class B systems. One is a box circuit connecting the boxes in series; the other is an alarm circuit connecting alarm instruments in fire stations and elsewhere. In Class A systems the box circuits are used for boxes only, and two sets of alarm circuits are provided. In Class B systems the box circuits are also used as alarm circuits. Class C systems using only a single circuit, all boxes and alarm instruments are connected in series.

The requirements for the material and construction in both kinds of circuits are the same. Fire alarm circuits are what are known as supervised circuits, i. e., they are or should be all-metallic and normally closed. As such, a defect is quickly detected. In actual practice there is more or less variation in material and construction in the different cities, but for our purposes here we will keep to the requirements of the National Fire Protection Association as they are now the standard for all construction.

In our opening remarks we stated that "alarms may at all times and under most adverse conditions be transmitted." To fulfill this requirement, the regulations and modern practices recognize underground ducts as the safest place for fire alarm wires. In any case, under ground is the safest place for all wires. Experience of the last few years, in a number of cities which have suffered from severe storms, has shown that only those circuits entirely underground were kept in continuous service.

"To secure the largest measure of protection and reliability in the operation of municipal fire alarm systems, all wires outside of buildings should be placed underground. The two sides of a circuit should be, so far as practicable, run in separate cables and by separate routes. Conductors shall have an approved rubber insulating covering. Wires or cables shall have a lead sheath. Underground wires shall be of copper—not less than No. 12 B. & S. gage when single wires are used, not less than No. 14 B. & S. gage in cables of less than four conductors, and not less than No. 16 B. & S. gage in cables of four or more conductors. No cable shall be installed in the same manhole with high-potential circuits, nor in the same duct with any conductor or cable of other than municipally controlled signaling services, except that, by consent of the Inspection Department, circuits may be carried in cables with circuits of other signaling systems."

Wherever municipal ducts or ducts of signaling systems can be secured, the city should place its wires underground for safety, for better service, and for appearance. It may be cheaper to use telephone wires, but it is apt to be poor policy in the long run. The telephone companies are forced to use a type of insulation and size of wires very deficient from a fire alarm standpoint. Their currents are weak and the number of wires is great, so they use very small wire, bunched in a large cable. By reason of induction troubles and limitations of space, they must use paper insulation, although leading telephone engineers tell us they would prefer to use rubber insulation if they could manage it. A recent type of underground construction is to lay steel-armored cable, practically a submarine type, directly in the ground, perhaps inside the curb line in residential sections. This is cheap and mainly satisfactory.



Courtesy National Board of Fire Underwriters

Section of fire alarm cable. The core consists of stranded common conductor, surrounded by a layer of insulation. Next outside of the insulation is a layer of individual No. 16 common conductors, insulated. The cable is bound with tape and covered by a lead sheath.

It was stated above that subways built only for fire alarm cable or telephone subways are the only ones available, but unfortunately these cannot be built to cover the entire area of a city because of the expense. It then becomes necessary to place some wires on poles.

The overhead circuit should be of insulated wire, in order to avoid leaks and crosses. If the insulation is poor, it may readily happen that at some point of the circuit the leakage will result in shunting the current around, so that the operation of a box will not break and make the circuit effectively, and thus the signal will be lost or jumbled. Furthermore, faulty insulation is an invitation to crosses with foreign current, causing burn-outs. Some departments are still using bare wire and depending upon a dry climate or trimming of trees to prevent leaks and crosses, but sometimes it rains or the air is damp, and sometimes there will be contacts with trees or other objects. It is better to use properly insulated wire and be safe.

The use of copper or copper-clad steel wire is recommended for durability. Iron wire is strong and the large sizes have sufficient capacity, but it quickly corrodes, except in especially favorable locations. The National Fire Protection Association committee has recommended that aerial wires for municipal fire alarm systems be equivalent in conductivity to No. 10 galvanized iron and in tensile strength to No. 10 hard-drawn copper, and that when spans exceed 150 feet, the cross-section area be increased. It was formerly the general practice to place fire alarm wires on tops of poles, but experience has demonstrated that it is much better practice to place these wires below all others. Fire alarm circuits, being for emergency signaling purposes, must be maintained in continuous service, irrespective of weather conditions. The fire alarm lineman will, therefore, be called out for repair purposes regardless of the state of the weather, and it is much easier for him to make repairs on wires which are on the lower cross-arms of poles. The fire alarm wires are generally about the weakest, from a mechanical standpoint, of any wires on the pole. Linemen from the electric light company are prepared for handling high-tension currents as they usually work during daylight hours and under more or less favorable weather conditions. It is much easier for them to go to the upper portions of the pole for repairs on the high-tension wires.

The two sides of a circuit are generally carried in separate cables and on separate pole lines. In case of a falling dry limb or power wire, there will be only one break to repair and, by grounding at boxes on either side of the break, the circuit may be maintained in service. Similarly, in underground cables, an accident will call for but one repair. There is a case on record where both sides of a number of circuits were in the same cable, and a workman pierced a duct with a pick, putting fire alarm protection over a considerable area out of service by grounding all of the wires in this one cable.

The overloading of circuits is quite a common occurrence. It is recommended that not more than 20 boxes and instruments be connected to a box circuit, and not more than five fire stations to an alarm circuit. This is partly to keep down the resistance, but is mainly to keep too wide a territory from being without protection.

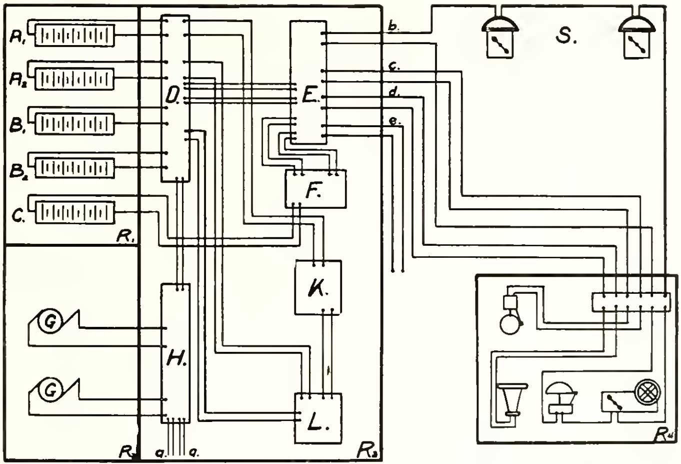
The circuits now bring us to the central office or headquarters. Before taking up the equipment, let us consider briefly the building. A number of cities, including Portland, Maine; Paterson, New Jersey; Waterbury, Connecticut; Jacksonville, Florida; and San Francisco, California, have had very costly experiences regarding their fire alarm systems. These have shown that the only safe building for fire alarm headquarters is one of fire-resistive construction, containing as little combustible material as practicable, and with openings protected against outside exposure. If the building is remote from other buildings, as in a park, all the better. San Francisco and New York have recently erected new headquarters in parks. It is not necessary to place the office at fire headquarters, or in the midst of a congested section. A central geographical location will usually give a better distribution of circuits, and in most cases, remove the office from the path of a possible conflagration.

Circuits should enter the building under ground and be protected in every possible way from possible interference and accident. Recent experience has shown that the protection of cables inside the building cannot be carried too far. Unless the cables are enclosed in a fire-resistive duct which is kept closed, a slight fire or excessive heat may put the entire system out of service. Cables are usually carried to a terminal board with a terminal for every wire, where cross-connections and changes can readily be made.

After leaving the terminals, the circuits pass through various protective devices. In a small office they may be located on the charging switchboards; in a large office it is more convenient to have separate protector boards. Each conductor should have a heavy current fuse, a lightning arrester, and sneak current protector.

The heavy current fuse should open with three to five amperes of current. A fuse is of no value that does not protect the instruments, and many contact parts and coils will not stand a heavier current indefinitely. Fuses should be arranged to be readily renewable without danger to the operator, and so constructed that the blowing of a fuse will not throw molten metal about the room or leave an electric arc.

The lightning arrester may be choke-coil, carbon air-gap, or vacuum type. Each has advantages and defects. Telegraph companies use choke-coils largely; telephone companies favor carbon air-gaps. The common brass air-gap arresters furnished with many switchboards and old-style boxes are practically worthless.



Courtesy National Board of Fire Underwriters

Automatic fire alarm system; aerial circuits.

A. Storage battery in duplicate—box circuit.
B. Storage battery in duplicate—alarm circuit.
C. Storage battery—telephone system.
D. Battery control board.
E. Terminal protector and test board.
F. Telephone desk.
G. Motor generators in duplicate.
H. Power switchboard.
K. Registers.
L. Repeaters.
S. Street boxes.

R_1. Battery room.
R_2. Generator room.
R_3. Operating room.
R_4. Engine house.

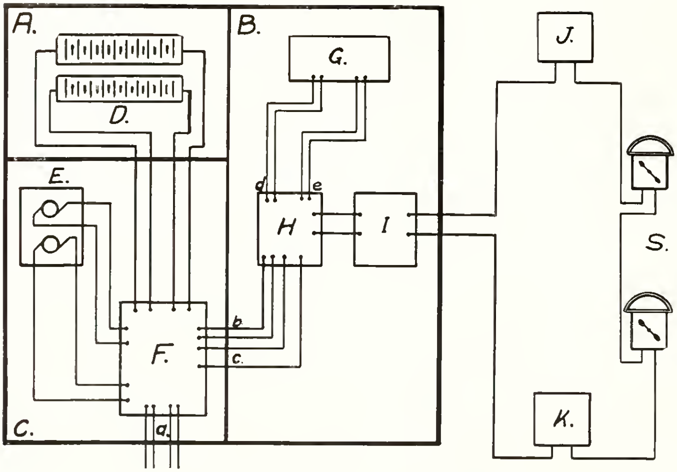
a. Power supply in duplicate.
b. Box circuits.
c. Alarm circuits.
d. Telephone circuit.
e. Telephone trunk to public exchange.

The heavy current and sneak current protection may be combined in one fuse or may be separate. Different installations use the telephone type of sneak-current fuses, grasshopper fuses, heat-coil fuses, electro-mechanical circuit breakers, or heat coils combined with heavy current fuses. The telephone companies generally use a heat coil combined with a spring, which snaps the circuit open at the melting of the coil. The mechanical circuit breakers are subject to corrosion and sometimes do not operate under considerably heavier current than intended.

As previously stated, for cities up to about 100,000 population, the automatic central office of Class B system is generally satisfactory, as there are not likely to be enough box alarms to require the constant attendance of an alarm operator. The essential features in such an office are protection to the instruments; a switchboard for controlling, charging, and shifting batteries; testing instruments; registers; a repeater; and the batteries.

For transmission in an automatic office, the automatic, non-interfering repeater is now the standard mechanism. In a manual office the usual means of transmission is a manual transmitter, although some offices still use the Morse key.

The automatic repeater is a device, now some forty-three years old, for transferring code signals from one circuit to a number of other circuits, and at the time locking out the other circuits between the strokes of the incoming signal so that the other circuits cannot send any signals and interfere with a signal already started. This is essentially a series of electromagnets, one pair for each box circuit, suitably connected by interlocking mechanisms attached to the armatures of the magnets, so that between the strokes of the incoming signal the magnets of all the other circuits are locked out. In addition, by means of suitable clock-work and escapement, and revolving drum contacts, the repeater sends out over all the other associated box circuits, and to any alarm circuits which may be in connection, the signal coming in. The same, or rather a similar, effect may be produced by suitable relays placed upon a control board or some other operating board in a central office. The alarm circuits are operated from contacts opened and closed by cams on the drum shaft. Obviously signals originating on an alarm circuit cannot be passed through the repeater.



Courtesy National Board of Fire Underwriters

Fire alarm circuits, manual system. Box circuit and power supply.

A. Battery room.
B. Operating room.
C. Generator room.
D. Storage battery in duplicate.
E. Motor generator in duplicate.
F. Power switchboard.
G. Instrument board.
H. Protector and test board.
I. Terminal board.

J, K Feeder terminal post.
S. Street boxes.

a. Power supply in duplicate.
b. Local power bus.
c. Main power bus.
d. Local circuit.
e. Main circuit.

A timing fan is connected so that, upon the opening of any circuit, that circuit remains in control for an interval slightly longer than the longest space between any two consecutive strokes of a complete cycle of any box on the circuit; the box having once commenced to strike, it cannot be interfered with by any box on any other circuit until it has completed its cycle and transmitted its signal to all the other connected circuits. After this the repeater automatically restores all of the circuit magnets to their original condition and the system is ready to transmit any other signal. In connection with the non-interference box, this invention has made it possible to operate a relatively large fire alarm telegraph system without having operators on duty.

In a manual or Class A system the usual means of transmitting signals is through a manual transmitter, although some cities still use the Morse key operated by hand. There are several types of manual transmitters. Some have circular number dials or plates, one over the other, set by small finger pieces—sometimes in two, three, or four sets, permitting transmission up to sixteen consecutive figures. A few have large, flat, rectangular number plates with vertically moving levers sliding into notches. Some have horizontal number bars with small sliding clips, and others are of the break-wheel type with detachable wheel for each box or assumed box location. In some transmitters, the moving parts are fragile and delicate and difficult of quick operation. In general, rather heavy construction and large figures seem desirable for apparatus that must be set hurriedly and amidst the confusion of incoming signals and telephone calls. Many of these instruments are of two-speed type, so that a few rounds of an alarm may be sent at high speed over gong or register circuits and then succeeding rounds at slow speed over gong or tower bell circuits.

The switchboards forming parts of fire alarm systems are of various kinds and types as suited to the desires of the superintendent or manufacturer. Many of these in the past have contained a number of useless parts and were unnecessarily complicated. Briefly, the switchboard should provide means for testing for trouble, for charging and operating storage batteries, and for operating the system. Registering devices should be installed to record all signals and the time of all signals going through the office.

Previous mention has been made of the different kinds of circuits. Irrespective of the class of the system, two circuits should enter each fire station with suitable receiving instruments on each.

For automatic systems it is desirable to have at least one alarm circuit, separate from box circuits, to enter each fire station. Then in case the box circuit is out of order, the station will still receive alarms. A tapper and punch register should be on the box circuit and a gong on the alarm circuit. Trip magnets, lighting switches, etc., should be on the gong circuits. Some departments have open local circuits from the gongs or from relays on the gong circuit, running to firemen's houses or to work places in the neighborhood of stations. This is quite desirable where call men are employed, or where the companies are undermanned at meal hours.

For a city large enough to use a manual system, there should be two independent, separate alarm circuits entering each fire station—one for the gongs and one for registers and tappers. Of course, in a manually-operated system, instruments on a box circuit will sound only alarms originating on that circuit.

The supply of current to the fire alarm system must be reliable and uniform. In recent years the storage battery in duplicate has come to be the accepted standard for fire alarm work. A cell of five- or six-ampere-hour capacity is generally used, and sufficient cells are connected in series for each circuit. One set of batteries operates the system each alternate twenty-four hours, while the other set is being charged.

The batteries are charged direct from a d-c. circuit through resistance, or from rectifiers, or motor generators. The latter method is preferable. A few of the larger cities are using common batteries and several, as Chicago, are using dynamotors. To be installed in a satisfactory manner, the batteries are mounted on glass rails, carried by porcelain supports on metal racks, in a well-ventilated room. The gravity battery formerly much used in fire alarm work is cheap to install, but somewhat unreliable and very dirty. It is fast being replaced.

THE NEW HOLY TRINITY CHURCH

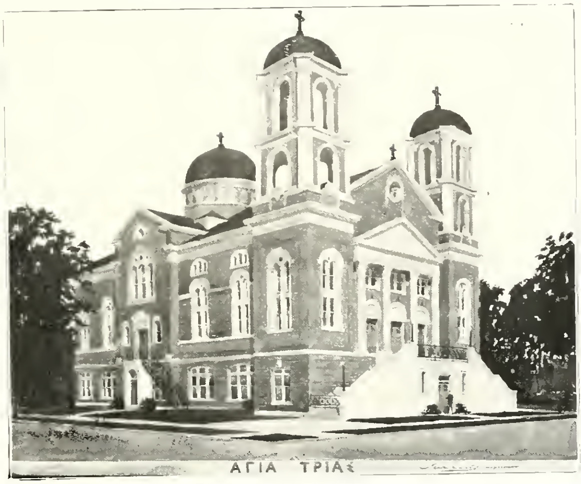
AN ACCOUNT OF ITS STRUCTURAL DESIGN

By

GEORGE D. ARACHOVITIS, '25

THERE is a growing tendency among architects to incorporate in their ecclesiastical structures characteristics of Byzantine architecture. Several examples of this are to be seen in some of the most recent buildings of our own city. In some cases this unusual architectural design introduces peculiar engineering problems. It has been the good fortune of the writer to design the structural plans for the new Holy Trinity Church of Chicago, a Greek Catholic church.

The architecture of the Greek Catholic Church, which is the ecclesiastical architecture of all the nations of southeastern Europe, is the original Byzantine with some classical additions and local modifications. The architecture of Byzantium, which dates from the fourth century A. D., bloomed gloriously during the sixth century under Justinian when Saint Sophia, Constantinople, the best existing example of the grandeur of Byzantine architecture, was erected. Along with the introduction of Christianity into southeastern Europe and Russia, there was also introduced the Byzantine architecture. Under the Latin emperors whom the crusaders raised to the throne in the thirteenth century, and under the Paleologians who succeeded them, Constantinople itself ceased to produce important works of art. However, the architecture of Byzantium flourished in the new nations which were springing up and in certain provinces which still remained tributary. This development is seen at its best in Greece proper, Epirus, Macedonia, and Asia Minor.



Architect's drawing of the new Holy Trinity Church, to be built at Loomis Street and Macalester Place, Chicago.

The fundamental plans of these Byzantine churches are governed by the domical method of construction. They are in the form of a Greek cross. The central space is covered with a dome, with subsidiary domes grouped around it. The early structures were constructed of stone and timber, the walls being built of ashlar, marble, or brick. The domes were built of stone as the only means of safe and durable construction. The present architect, in his design of a Greek Catholic church, has to follow the above mentioned general plan as a matter of well established principle, while the engineer is called upon to solve the problems of the Byzantine builders in terms of steel and concrete instead of stone and timber.

The designers of the Holy Trinity Church, J. T. Fortin, architect, and N. Docos, associate, based their plans upon the established characteristics of Byzantine ecclesiastical structures. The general plan is in the form of a cross with a dome over the ridge intersection. The over-all dimensions are 75 feet by 136 feet. The auditorium floor is 12 feet above the grade line. Two stone stairways, 8 feet wide, lead from the two sides of the front elevation to a central entrance platform. Entrance is made to the narthex and the main auditorium through the main doors at the back of the platform. In back of the altar are three circular alcoves, one of 18-foot, and two of 9-foot diameter. These alcoves are covered by a semiconical roof.

The ground floor, below the auditorium and 7 feet above grade, is to be used for Sunday School classes and general assemblies. For this reason, the architectural design allowed columns to be placed at the center only, in two rows 10 feet apart. These columns, besides carrying the large steel and reinforced concrete girders of the floor above, serve also as corners of the four classrooms which are formed with slide partitions and as supports for the partitions forming the hallway between columns. On this floor and below the altar is a stage, 3 feet above the floor line.

The basement, 9 feet below the ground floor, is entirely below grade and is ventilated by artificial means.

Two towers, 17 feet square and 101 feet high, are at the front of the building, one on either side.

The building is of fireproof construction. Both reinforced concrete and steel construction are used, depending upon the conditions imposed by the architectural treatment.

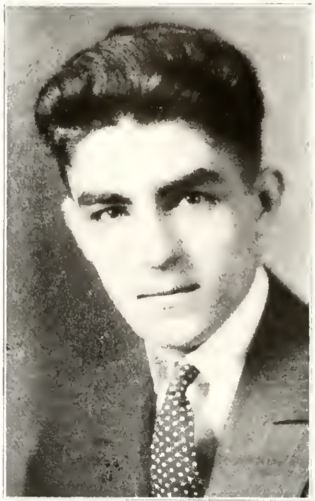
The plan of the roof is the same as the general plan of the floors, a cross being formed by the two ridge lines and the dome being placed at the intersection. The roof is of concrete, covered with copper tile. Seven trusses carry the roof system and dome. Of these seven, the four trusses supporting the dome are carried by four columns, while the other three are anchored to the wall. Unlike the typical interior Byzantine design, this church is to have no columns, save the four columns near the entrance, supporting the main balcony concrete girders. The ceiling cross-section is elliptical in form, the entire roof load being carried to the side walls by the roof trusses. Of the seven trusses, T_1 is 11 feet long and is located between the two towers. Trusses T_2 and T_7 are 62 feet long and are on either side of the dome-carrying trusses. Trusses T_3 and T_4

are 62 feet long and carry the entire weight of the dome, supporting wall, and central roof system. They are supported by four columns. Trusses T_6 and T_7 are 27 feet long and are attached to the main trusses T_3 and T_4 at right angles, thus forming a square in plan, to support the dome columns.

The dome is 27 feet in diameter and rises to a height of 27 feet above the ridge line of the roof. The hemispherical dome rises from a wall which is in turn cylindrical, octagonal, and square. The dome is formed by two main trusses, A and B, at right angles to one another, and by twelve intermediate trusses, C. The main trusses, A and B, are firmly attached at the center by means of gusset plates and cover plates. The intermediate trusses are attached to the main trusses by plates in the same manner. The lower ends of all the trusses are attached to vertical columns. The four columns carrying the main trusses A and B are fixed at their lower ends to the vertices of the four trusses T_3, T_4, T_6, and T_7. The columns carrying the intermediate trusses are supported by horizontal **I**-beams attached to the upper chords of the four dome-supporting trusses, and are so arranged as to form a sixteen-sided figure in plan, including the sections of the truss chords above the **I**-beam connections.

The upper chords of the dome trusses are circular in form. Circular purlins connect the panel points of these trusses, thus forming a series of rings about the trusses. Where the trusses are connected to the columns, a circular channel is provided to brace and tie together the dome framework. In analyzing the dome stresses and the wind effect, it was assumed that any one of the four main columns resisted half the wind thrust. The intermediate columns were designed for their proportional thrust, the maximum being that carried to the columns by three intermediate trusses—a force equivalent to a fourth of the entire thrust. The main objective in designing the dome was to eliminate as much as practicable all deflection in the steel members. For this purpose the dome was designed to consist of trusses instead of radiating rib arches, which were found to be too flexible. The intermediate trusses C carry half their proportionate load onto the main trusses A and B by means of their connection to the top dished plate. The dome columns are braced by a circular ring just below the windows in the circular wall. The masonry work of the dome proper and lower sections is carried by the trusses forming the dome base. The total load of masonry and steel in the dome sections and supporting trusses amounts to about 100 tons.

Trusses T_2, T_3, T_4, and T_5 are of the Fan type with cambered lower chord to allow for the elliptical ceiling. Truss T_1 is of the Fink type and trusses T_6 and T_7 are Fan trusses.



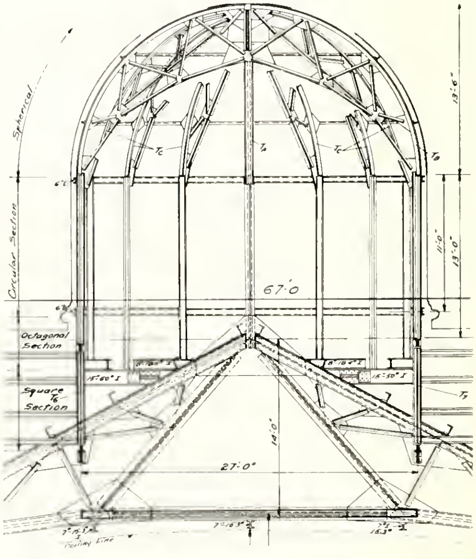
Mr. George D. Arachovitis.

Trusses T_3 and T_4, which carry the dome, are comparatively heavy due to the central location of the loads and to the length of the spans. Box sections were found to be the most suitable in forming connections, as well as simple and economical for fireproofing. Trusses T_6 and T_7 fall a foot below the upper chords of trusses T_3 and T_4, the framing at these points being made by means of hanging connections. The four columns which carry T_3 and T_4 are 52 feet long. Stiffness acquired from the wall surrounding them was neglected because of their relative location. To reduce the effective length, two channels are attached to each column, half way between ends and at right angles to its axis, and embedded in the brick wall. In addition to diminishing the effective length of the columns, this scheme secures additional stiffness. The bracing of these columns through any other direct frame connection was impossible, due to the projections of the side walls.

The floor of the **U**-shaped balcony is 11 feet above the auditorium floor. It is constructed entirely of reinforced concrete. It consists of three sections, the two side sections, 25 feet long, and the central section, 31 feet 6 inches long. The two side sections are carried by two inclined girders framing into one of the two main girders on one end, and into the side wall at the other.

The central section extends to the front wall of the building and is carried by four inclined continuous girders. These girders are supported at the lower end by a cross-girder and at the upper end by a large concrete girder spanning from tower to tower and carrying the portion of the front wall above it in addition to the inclined girders. The intermediate support is a column below each girder. The entire balcony is carried by two large girders, 50 inches by 36 inches, forming the sides of the **U** and spanning from the front part of the balcony to the front wall of the building. The cross-girder mentioned before is framed into them to form the **U**. These main girders are supported at four points, two of the columns being made of steel and located in the back part of the auditorium. Various framing schemes of the balcony so as to eliminate the use of columns on the auditorium floor were impracticable because of the headroom limitations and the extension over the main entrance

(Continued on page 156)



The large central dome, showing the supporting trusses, T and T_4.

THE ARMOUR ALUMNUS

PROF. J. C. PEEBLES, *Editor*

As announced in this department some time ago, the first local branch of our association was established by Armour Tech men at Detroit. We have had very little news about the doings of this branch, so we are pleased to present at this time a letter from their secretary, **R. N. Mann, '18.**

THE ALUMNI ASSOCIATION IN DYNAMIC DETROIT

The present officers of the Detroit Branch of the Armour Alumni Association are as follows:

President: **A. N. Koch, '14**
2683 Sturtevant Ave.
Telephone Hemlock 1595-R
Vice-President: **O. L. Cox, '23**
Mich. Inspection Bureau
Secretary-Treasurer: **R. N. Mann, '18**
707 Un. Trust Bldg.
Phone Rand. 6442

Meetings are held at 12:30 p. m. on the first Thursday of every month at Briggs' Restaurant, Stroh Building.

All Armour men visiting in Detroit are invited to attend these luncheons, or to communicate with the secretary when they are in Detroit.

The Armour Association is affiliated with the Detroit Intercollegiate Association, consisting of the alumni groups of over 150 colleges and universities. We have been taking an active part in this organization, and Harold Ellington is a member of the Executive Board of the Intercollegiate Association.

Our association now has over thirty active members. It has been found that there are a considerable number of Armour graduates throughout the state, and plans are being formulated to form a state-wide organization to include these men.

One of our most distinguished members in the Detroit branch of the association is **William R. Wilson, '06.** The *Detroit Times* published the following in their issue of March 22.

"At a meeting of the new board of directors of Copeland Products, Inc., of Flint, held in Detroit, William Robert Wilson, a director of the Bank of Detroit, and recently president of the Maxwell Motor Corporation, was elected president.

"This is the first move in the expansion of this company, which builds a line of domestic ice machines and refrigerating systems.

"While William Robert Wilson, the new president, will guide the destinies of the organization, it is announced that he will not devote his entire time to it, as other enterprises will also claim his attention."

Harold S. Ellington, '08, is our "Past Exalted Grand Ruler," being the man who was responsible for the organization of the Detroit Branch of the Alumni Association and our first president. He is a member of the firm of Weston and Ellington, Architects and Engineers.

One of his latest pieces of work is the new Metropolitan Building, a 14-story fireproof structure now nearing completion in the heart of the down-town district of Detroit. This monumental and beautifully designed office and store building is a splendid tribute to his ability.

Ellington also was the architect for the impressive 21-story Stroh Building, one of the most beautiful of our city skyscrapers, located at Grand Circus Park, which is the hub of the city.

Fred D. Farrar, '14, is another Armour architect who has established himself as one of the leaders of his field in Detroit, being a partner in the firm of Muehlman and Farrar.

Fred has been branching into other fields lately as evidenced by his striking cartoons, which have been appearing on the sport page and feature section of the Sunday edition of the *Detroit News*. Fred's cartoons have consisted of a group of grotesque figures engaging in popular sports of the times. During the football season he drew a group of football figures, and down in the corner was a man with a large letter "A" on his blanket. Recently he drew a group of figures engaged in winter sports, and the center figure was a burly fellow with an "A" on his sweater.

Fred is doing his best to give us some publicity.

George Letterman is our only representative of the Class of 1910. George lives in Walkerville, Canada, just across the Detroit River, and is doing noteworthy work on structural steel and bridge jobs. He has lived in Canada most of the time since his graduation and has established a reputation through his work in the Dominion. He is now anxious to return to his native United States, this in spite of the fact that Ontario has just passed a law legalizing 4 per cent beer.

We are always glad to welcome to our ranks new members among the recent graduates, and one of the objects of our association has been to aid these men in every way that we can to establish themselves in Detroit.

Richard Walworth is a native of Hillsdale, Michigan, and has recently become connected with the Detroit Steel Products Company. He is our only member of the class of 1924.

ARMOUR BASKETBALL TEAM—MICHIGAN TRIP

The Armour basketball team played three games with prominent Michigan college teams in February, the climax of the trip being in Detroit where the members of the Detroit branch of the Alumni Association had the pleasure of meeting and entertaining the team and their coach, and rooting for them at the University of Detroit game.

To those Armour supporters who may read the scores of this trip, and who may think the team made a failure of their Michigan invasion because they lost all three games, we of the alumni who saw them play want to emphatically state that we had no reason to be anything but

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HALF DAY

At 11:45 a. m. Chief Engineer Allen, dressed in the blue denim of his calling, emerges from the small door at the north end of the main building and starts across the street toward Machinery Hall. He is carrying a pint, not on his hip but in the side pocket of his jumper. As he enters the office of the Department of Mechanical Engineering, Professor Gebhardt looks up from his desk and notices the bulging pocket. The engineer sets the bottle on the table and the professor regards it without enthusiasm; he is evidently musing on these decadent and desiccated days, and remarks more to himself than to his caller, "How pints have changed!"

After sitting for a few moments in silent contemplation of the pint, the professor picks up the bottle and with Socratic fortitude drains it to the bottom and calls it a luncheon. Professor Libby, an inveterate radio fan, enters the office just at this moment and sees the "empty" sitting on the table. He suddenly develops an entirely unsuspected vocal ability, as with his eye on the bottle he paraphrases thus a recent radio rage—"How do you do, Sidney Wanzer, how do you do."

By this time Mr. Allen hears a ham sandwich calling from the engine room and so he starts back toward his own domain. As he recrosses the street he sees a man approaching from the west; they reach the door of the main building at the same time and enter together. The newcomer is a big fellow, dressed in gray suit and overcoat, with pearl gray hat and gloves. He seems anxious to get into the building without being seen, and once inside, he hurries to the elevator, long strides producing speed, rubber heels conducive to silence. It is John Schommer just arriving, full of pep, to start the day's work.

In the meantime two dignified professors are giving a demonstration of certain modern dances on the sidewalk running along Ogden Field toward the lunch room. Professors Huntly and Snow have started for lunch together, but after a few steps the latter finds that he is out of phase. By no amount of effort can he synchronize with Professor Huntly's swinging stride, physical limitations making it impossible. He suddenly discovers, however, that by increasing his natural frequency a bit, a sort of synchronism can be achieved, in which his period is just one-half that of his companion's. So they go down the street together, one step for Huntly and two steps for Snow.

In the lunch room everything is in readiness for the rush hour which comes at 12:20. At one end of the long counter near the cashier's desk stands a husky individual, who is checking over the final preparations. He has attended to the purchasing of the provisions and other supplies, has prepared the menu for the day, and has seen that the cashier has plenty of change. Notwithstanding his size and strength he is not the official bouncer. It is Mr. Nisbet, during business hours cashier of the Institute, but here secretary of the interior.

At 12:20 students begin to pour from all the buildings and start on a run for the lunch room, each anxious to be first in the bread line. Like an office-holding politician who prates about public service and then throughout his whole career consistently serves nobody but himself, the patron here must, for the most part, serve himself. Therefore, the first man in the line will avoid even a few minutes of waiting, will get his lunch promptly, spend a minimum of time in eating it, and make room at the table for some less fortunate fellow student. The room empties almost as rapidly as it filled, for all are anxious to spend as much as possible of the lunch hour outdoors. Even in Chicago spring sometimes comes, and it is here today. Soon the room is deserted, save for the attendants clearing up the tables, the cashier counting the receipts, and some introspective professor eating a solitary sandwich at the faculty table.

Many of the students have lingered on the athletic field where spring, like a perennial freshman, is in full possession. One group, evidently not candidates for the track team, are trying their hands at the discus. Something seems to be wrong, for mountain-size efforts bring forth throws of mouse-like proportions. Instead of gliding through the air like a swallow going "back home," the saucer hurtles over and over, like a football in a drop-kick. These young men know all about Newton and his laws of force and motion, but they never heard of Myron. Some of them are big fellows and have the necessary substance, but they are sadly lacking in form. Perhaps a little study of Greek art might help an engineer to apply his force with better effect, particularly in this ancient form of athletic sport.

Over in the supply store the candy counter is doing a rushing business. The manager is busy handing out candy bars with one hand and raking in the nickels and dimes with the other. Like the horticultural expert at the county fair, whose specialty is peas of the disappearing variety, he keeps up a steady flow of talk as if to divert attention from his hands. Sometimes, just because he feels that way and not from any desire to entertain the customers, he even sings a bit, in a mezzo voice which makes the words difficult to hear. By close attention, however, one may catch the refrain which runs—"Hi set me syle and syled awy."

It is now one o'clock and the students are returning to the various buildings for the next classes which begin at 1:10. Ogden Field and the streets nearby are practically deserted, in spite of the fact that they are much more attractive than the lecture rooms inside. One young man hurrying down Thirty-third Street, overtakes a group of students who are lagging along as if in no hurry to reach the class room. "Better hurry up, fellows, or you'll be late for bedtime stories." But it takes more energy to accelerate than to maintain a uniform pace; furthermore, the spring sunshine is not conducive to sudden outbursts of energy, so there is no perceptible change in their step. They are on their way to the great bane of the student's existence, the one o'clock lecture. When they reach the lecture room they slip quietly into rear seats, prepared to start the afternoon with a quiet nap under the soporific voice of the professor.

THE ARMOUR ALUMNUS

(Continued from page 139)

proud of the showing the team made. They played three of the strongest college teams of the state and put up the hardest kind of a battle in every game.

The Detroit game was a disappointing one to lose. There were about 50 ardent Armour rooters in the stands, consisting of alumni and their friends and families, and the boys fought desperately to win and send us home happy. Detroit's defense was a bit too strong for them, however, and the best they could do was to take the short end of a 15 to 13 score. The feature play of the game was a basket by Joe MacLaren, made while he was sitting on the floor, after having been spilled by two Detroit players.

The night before the Detroit game the boys played a hard game at St. Mary's College, near Pontiac. St. Mary's has been generally credited as the best team in the state outside of the University of Michigan, and went through the season without a defeat. Armour gave them their closest battle of the year, losing out by only two points. **Earl Merry, '03,** of Pontiac, and his young son; **Dick Mann, '18; Al Koch, '14;** and **O. L. Cox, '23;** were the Armour rooters at this game, and when they "sounded off" with the old "Arch-Mech" yell they sounded like a crowd of at least fifty. Their yelling efforts were highly applauded by the large crowd of St. Mary's rooters. The Armour team used a large number of substitutes in this game, as they were saving themselves for the Detroit game the following night, but even so they gave St. Mary's their hardest game of the year.

Western State Normal College at Kalamazoo gave the team another close defeat on Saturday night, following the Detroit game. This school always has a very strong team, and the Armour team was pretty well worn out after two hard battles on the two previous days.

The Detroit alumni entertained the team at the Fort Shelby Hotel at a luncheon, and greatly enjoyed the opportunity to meet the boys. The students made a profound impression with their singing of the Armour Fight Song at this affair. When the team is so crippled that they can no longer play basketball, they can always travel as the Glee Club.

The alumni in Michigan want the boys of the team to know that we thoroughly enjoyed their visit, and appreciated the splendid fight they made in the games played. Every man of us will be on hand next year rooting just as hard for them. We won't be satisfied until they finally beat Detroit, and the Armour spirit of perseverance is bound to accomplish that result in the end.

ALUMNI BANQUET

The alumni banquet will be held Tuesday, May 19, at the Club Chez Pierre, 247 East Ontario Street at 6:30 p. m. There will be music and entertainment furnished by the Club Chez Pierre from 7 to 9 during dinner. From 9 to 10 the alumni will transact what business is to be considered. The banquet committee is confident that no Armour alumnus will want to miss the fun and the reunion of old friends. This banquet is the twenty-fifth anniversary of the Class of 1900 and the tenth anniversary of the Class of 1915, giving the men of these classes an added incentive to be present.

Arthur M. Jens, '04, is a member of the newly formed insurance firm of R. E. James & Co. The firm is composed of Messrs. R. E. James, W. M. Murray, and Arthur M. Jens, and will conduct a general insurance business. Mr. Jens was formerly with the firm of Fred S. James & Co.

Samuel E. Shafer, '02, is sales and production engineer of the Chain Belt Company of Milwaukee. Engineering runs in the family and his son is now taking engineering at the University of Wisconsin.

Nels H. Erlandson, '02, is now located at Daytona, Florida. He is in charge of a service station there handling several makes of motor cars.

Don R. Frary, '04, is now located in Philadelphia at the Lumbermen's Insurance Company.

Paul V. Frary recently became the eastern financial manager of the H. F. Wilcox Oil and Gas Company.

P. F. Auer, '14, is in St. Louis with the James Stewart Construction Company.

W. Bell, '12, is general supervisor of traffic, Illinois Bell Telephone Company.

Hubert E. Willson, '15, is now development engineer in charge of the Kearny Building specifications and layouts of the Western Electric Company.

Milton Grill, '21, is in the research department of the Western Electric Company and is developing wood and iron working methods.

Charles L. Bolte, '17, was a recent caller at the Institute. Many an Armour man who later served with credit and distinction during the great war received the first rudiments of his military training from Mr. Bolte. The awkward squads, faculty included, which he drilled on Ogden Field all remember him as an efficient military instructor. He is now Captain Bolte, stationed in Washington, where he is attached to the staff of General Hines, chief of staff.

W. D. Matthews, '99, is in a foxy business far removed from engineering. To be specific, he is running a silver fox farm in Wausau, Wisconsin. Evidently this type of farming beats the conventional kind carried on with plow and hoe. But let Mr. Matthews tell it in his own words; strange words for an engineer, but perhaps not so strange for a fox farmer

I left my dad, his farm, his plow,
Because my calf became his cow;
I left my dad—'twas wrong, of course—
Because my colt became his horse.
I left my dad to sow and reap,
Because my lamb became his sheep;
I dropped my hoe and stuck my fork,
Because my pig became his pork.
The garden truck I had to grow
Was his to sell and mine to hoe.

I stuck by dad, his farm, his plow,
Because my dad had notions how
To ease our life of sweat and toil,
And enjoy ourselves, close to the soil.
This deed he did, in years quite few,
Starting right, and going through
With silver foxes, mortgage breakers,
Things of beauty—money makers.
I'm still with dad—root and branch,
"Sittin' pretty" on *our* Fox Ranch.

S. D. Apostol, '22, after graduation entered the Commonwealth Edison Company, distribution department, where he went through a series of changes and promotions. At present, Mr. Apostol is located in the circuit division of the distribution department where he holds the position of circuit engineer.

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EDITORIALS

GIVING ADVICE TO SENIORS

Commencement day is a time of best wishes and of advice to college graduates. Apropos, and because it will stimulate the thought of every reader in a channel in which stimulus is needed, we are delighted to present this view of giving advice to seniors by Dean Potter of Purdue University, quoted from the *Journal of Engineering Education.* We hope that the current ubiquity of excellent advice will dissuade no one from reading Dean Potter's message.

"We engineering teachers have the great responsibility of guiding our students and particularly those who are about to graduate and to take their places in industry.

"Are we assisting our senior students in making an inventory of those things they should be and should have because of their engineering training? Do they realize the importance of character in determining their success in life? Do they appreciate the fact that their mind will keep on growing as long as they exercise it, or do they look on Commencement as the end and not the beginning of study? Do they recognize that the most successful people owe their positions in life mainly to hard work, or are they looking for an easy job? Are they striving to develop such traits of personality that people will enjoy associating with them, or will they limit their advancement by a poor personality, by such handicaps as poor address, awkwardness, self-consciousness, indifference, conceit, or indecision? Do they realize the importance of friends and do they know how to find, make, and keep friends? Has their college education assisted them in developing their aesthetic tastes, with the joys of appreciation of the best? Are they capable of using their leisure time advantageously to themselves and to others? Has their educational equipment prepared them for responsible citizenship and have they sufficient vision to utilize their knowledge for the benefit of society, or are they narrow minded and unable to detect the fallacies of the propagandist?

"Are we giving our senior students proper assistance in deciding upon their careers? Do they realize that a person is happiest when in an occupation which suits his inherent ability and personality? Do they appreciate the fact that service, the objective of every worth-while career, is to be considered in the light of one's talents and interests together with the opportunities offered for the assumption of responsibility? It is not what the young man thinks what he would like to do but what he is fitted to do that will determine his success. The senior student must also realize that in the engineering profession greatness is measured less in money and more in service and accomplishment.

"Are not many of our young graduates sacrificing their future through impatience or by accepting positions which pay well but in which they gain too little experience in preparation for greater responsibilities? Do they realize the importance of gaining their practical experience while they are young and the difficulty of securing a variety of experience after one has dependents? Are they aware of the fact that a college education does not guarantee success, but that their future depends upon their ability to do every task better than the average, upon the use they make of their knowledge, and upon the pains they take with their work and their preparation?

"Are we encouraging the more gifted of our senior students to prepare themselves by graduate study for teaching or for research careers in connection with which they may have an opportunity to lay the foundations for future engineering progress, to do constructive and enduring work of vital importance to humanity?

"Our students about to graduate must be impressed with the fact that they have had educational advantages which should have developed in them courage to do right, ability to think straight, willingness to work hard, personality to make them acceptable to their fellowmen, disposition to make friends, aesthetic tastes to enjoy the beautiful, and breadth of vision to take their place as citizens in their communities."

It may come as a distinct surprise to the senior to discover that people have so concerned themselves over his well-being. Yet, finally, the impulse to achieve the very best that life has to offer must come from within himself. His bid for perfection must be his own personal desire for enduring work, character, friends, and beauty. Commencement day ideals are high. They need to be counterbalanced by the sober thought that their attainment is an organic process. Completeness cannot be reached in a day or by conception alone. And a mistake now and then does not destroy all that has gone before. Four years have taught much, but the senior is still young. His whole life lies ahead.

POETRY AND SLIDE RULES

In a recent bulletin, the committee in charge of the Investigation of Engineering Education has stated that an aim of the investigation is "To provide more effective articulation of instruction in the various subjects which make up an engineering curriculum." Although the bulletin hints at the especial need of cooperation in the teaching of mathematics, physics, and mechanics, in connection with each other and with the teaching of technological subjects, there is no need for confining this advice to scientific, mathematical, and technical courses. Infinite possibilities exist in the actual linking of those subjects which compose the particular sphere of a technical college with those of a liberal nature.

Suppose that hydraulics, steam power plants, or alternating currents were taught in Spanish, French, or German;

(*Continued on page 151*)

COLLEGE NOTES

On April 21 it was announced that Vincent Viscariello of the Class of 1926 had won the prize and a first medal in the Emerson Prize Competition of the Beaux-Arts Institute of Design in New York. Other awards to Armour men in this competition were Jacobson, first medal; Lynch, first mention; and Flint, first mention.

The Emerson Prize is an annual prize of $50, donated by Professor Emerson, a patron of the Beaux-Arts Institute of Design. It is competed for by all of the colleges taking B. A. I. D. work. The problem for the competition was "The Tomb of an American President in a Cathedral." The results are especially gratifying to us, inasmuch as only five Armour men entered the competition.

The picture which was on display in the lobby during the early part of April is the gift of the members of the faculty of the Armour Institute of Technology to the new Gunsaulus School. The artist is Karl A. Buehr.

The dedication of the Gunsaulus School, which is located at Forty-fourth Street and Sacramento Avenue, took place on Friday, April 17. It is named in honor of the memory of Dr. Frank W. Gunsaulus. In view of his special interest in art, the building has been made a model of architectural design. The picture is a contribution to the artistic interior decoration of the school.

THE INTER-HONORARY INFORMAL

The fifth annual Inter-Honorary Fraternity Informal Dance at Armour Tech was given on April 24 at the Ambassador Hotel. The same room was used as for the last dance of this kind, for it afforded a coziness that is not available at many other places, with the result that everybody felt at home. The music was the best and harmonized well with the dangling of the keys on the watch chains. The pep of Castle's five serenaders seemed to be contagious, the magic strains filling the dancers with an ecstasy that dispelled alike the worries of the most overworked Junior and the responsibilities of the gravest Senior. Faculty members were out in good number as were also the alumni, eager to form new friendships and glad to renew old acquaintances. The evening was all too short and the participants left, consoled by the knowledge that next year they could attend a similar happy affair.

Pi Tau Sigma received a hearty welcome as a new honorary fraternity and the disciples of Carnot maintained the standard of the others by putting away the steam tables and coming out in full force. The dance was sponsored by eight honorary fraternities, Tau Beta Pi, Sphinx, Eta Kappa Nu, Scarab, Phi Lambda Upsilon, Salamander, Chi Epsilon, and Pi Tau Sigma. The success enjoyed by the dance was due to the cooperation of the honoraries and to the efforts of E. S. Larson and his committee.

The annual Inter-Honorary Fraternity Dance helps greatly in bringing together students whose endeavors at the Institute have been rewarded and in bridging the gap between the students and the alumni. Its continuance is much to be desired.

The Office of the Dean has announced that the college year 1925-1926 will commence on September 21. This is one week later than the date announced by the Bulletin of May, 1924. The end of the term in 1926 will be correspondingly later. Adoption of the new period assures at least an extra week of time between the end of the Christmas vacation and the end of the first semester. A further advantage will be the shortening of the interval between the close of college in May or June and the opening of the summer session. The baseball team will be benefited by an increase in the length of the playing season.

The regular summer session of the Institute will begin Monday, June 22, and will end July 31. The summer courses are of advantage to mechanics, apprentices, and teachers of manual training, as well as to new students or undergraduates seeking to remove conditions.

About forty students from the Civil Department are expected to attend the Armour Tech Summer Surveying Camp this year. The men will leave for camp on Friday, May 29. Field work will commence the following Monday. The enjoyable session at Trout Lake is of six weeks' duration.

Professor John C. Penn has completed a survey made at Armour Institute of Technology for the purpose of determining the percentage of students earning money to defray their expenses, in whole or in part, while attending college. A questionaire which was circulated among the student body requested answers to the following queries:

"Approximately what per cent of your living expenses (board and room, clothes, etc.) do you earn during the summer vacation? What per cent during the college session? Approximately what per cent of your college expenses (tuition, fees, books, supplies, etc.) do you earn during the summer vacation? What per cent during the college session? What is the nature of the work during the summer? What is the nature of the work during the college session? Are you a citizen of the United States of America?"

Returns were obtained from 679 students, representing 93 per cent of the student body then in attendance. Four United States Veterans' Bureau students and 92 Western Actuarial Bureau Scholarship students are included in this total. Twenty-three students stated that they were not citizens of the United States. The following countries are represented: Canada, Poland, Russia, Hungary, Greece, China, British India Servia, and Syria. The results of the inquiry are shown in the accompanying tabulation.

Unfortunately, the tabulation cannot show the number of students who earn nothing at all; i.e., nothing in the summer vacation and nothing during the college session. Neither can it show the number who earn all of their expenses while attending college. It may, however, be inferred that about 30 per cent earn nothing either in the summer or during attendance at school and that about 7 per cent earn all their expenses during the summer vacation and while in attendance.

In a few cases, and entirely without design, students were asked to fill in the questionnaire for the second time. In every case the duplicate report differed very materially from the original. From this it may be concluded that very few students keep accounts, or even keep count of their expenditures and earnings well enough to fairly answer such a questionnaire as the one submitted. However, the results truly indicate that about one-third of the students are entirely dependent and that the others are actually earning money to pay their expenses while attending the Institute.

When it is considered that an average program requires an actual attendance of about 32 hours, and that not less than 18 hours a week of preparation are required for the work at the Institute, it is remarkable that so many find time to do outside work.

The following is a partial list of the various kinds of jobs held by the students: Insurance rating, 75 (Western Actuarial Bureau students); draftsmen, 83; laborers, 52; clerks, 76; in shops, 34; salesmen, 50; chauffeurs, 16; electricians, 20; inspectors, 5; farmers, 8; mail carriers, 8; bookkeepers, 3; watchmen, 3; painters, 4; window trimmer, 1; stewards, 3; life guards, 2; surveyors' helpers, 13; tutors, 4; appraisers, 2; chemists, 18; banking, 1; engineers' helpers, 1; radio, 9; janitors, 3; tailors, 2; guide, 1; steamfitters, 2; postal clerks, 5; stationary engineer, 1; news carriers, 2; carpenters, 7; filling station attendants, 5; time keepers, 4; collectors, 2; ushers, 2; hay baler, 1; boilermaker, 1; barbers, 2; sheet metal workers, 1; meter tester, 1; librarian, 1; bricklayers, 2; advertising, 1; elevated railroad guards, 2; florist, 1; stenographer, 1; telegraph operator, 1; musicians, 11.

(Continued on page 154)

Percentage Earned	0	1-25	26-50	51-75	76-99	100
Living Expenses—Summer Vacation.......	30.2	22.8	15.6	4.4	3.1	23.9
Living Expenses—College Session..........	62.4	19.5	6.9	2.8	2.8	6.6
College Expenses—Summer Vacation......	30.4	13.3	18.9	10.2	5.6	22.0
College Expenses—College Session........	66.7	14.2	6.8	2.8	1.2	8.4

The figures in the table show the percentage of the total number of students who earned the amounts (percentage of total) indicated at the head of columns.

SOCIETIES

AMERICAN SOCIETY OF MECHANICAL ENGINEERS

The Armour branch of the A.S.M.E. held its annual smoker on April 16, at the Theta Xi house. A smoker furnishes the one time when a Mechanical can make smoke to his heart's content without interference from the authorities. Seniors and Juniors, ably assisted by members of the Faculty, were out in full force to do justice to the occasion. George Rose plus his exceptional orchestra furnished entertainment of superior caliber. Hot battles over the card tables were waged between Seniors and Faculty. Even to this late day the issue remains in doubt. Last but not least, those were some eats!

The week of April 13—18 was Gas and Power week. Professor Roesch spoke to us on the topic of "Practical and Laboratory Experiments with Gas Engines." Altogether we have had a very good year and we pass on the organization to the class of '26 with every wish for good luck.

WESTERN SOCIETY OF ENGINEERS

During the past year the Armour branch of the Western Society of Engineers has secured many prominent men to present talks to the members. Among those who have addressed the Armour branch are Mr. E. T. Howson, president of the Western Society of Engineers, Mr. R. M. Ford, assistant chief engineer of the Rock Island Lines, and Mr. Des Jardins, of the Standard Oil Company. The high positions which these men hold in the engineering world vouch for the value of their talks. On March 19, Mr. T. L. Condron gave an illustrated lecture on the South Park Boulevard viaduct, now under construction, which is to span the Illinois Central right-of-way at Twenty-third Street. Mr. Condron is the consulting engineer on this structure. In the afternoon, following the lecture, Mr. Condron led the Junior and Senior members of the society on an inspection trip to the viaduct. Members of the Armour branch owe Mr. Condron their heartiest thanks for the pains he has taken in their behalf.

Several members of the Armour branch accompanied the April excursion of the Western Society on an inspection trip to the Niles Center Extension of the Chicago Rapid Transit Lines, Saturday afternoon, April 11. A special train carried the party over the five miles of newly laid track from Howard Street to Niles Center. Stops along the way were made to inspect the subway under the Northwestern tracks, the bridge over the North Shore Channel, the automatic substation at the far end of the line, and several of the station buildings.

On Friday evening, April 3, the second smoker of the season was given at the Phi Kappa Sigma house. Entertainment was furnished by Mr. Chun and his Hawaiian Quintet; Mr. Douglas, well remembered by upperclassmen as the organizer of the Armour Tech Band; and a silhouette farce presented by the Chi Epsilon pledges. A three-piece jazz band furnished music while the "feed" was being distributed. The verdict was, as usual, "Good smoker!"

On Thursday, April 23, Mr. Reynolds, assistant city engineer, closed the season with a few tips on "The Value of the Engineer to Society."

Meetings have set a new record for attendance, there having been at times over two hundred students at one meeting. We feel assured that the reputation of the W. S. E. has been upheld in every way during the college year, both as to attendance and speakers.

In closing the season, we acknowledge our indebtedness to all of those students who have supported our meetings throughout the year and we wish to take this opportunity to thank all the men who, by giving some of their time to us, have succeeded in imparting to younger men a portion of their knowledge and experience.

FIRE PROTECTION ENGINEERING SOCIETY

Several good talks have been presented to the Fire Protection Engineering Society by prominent figures in the insurance world, chief among whom were Wellington R. Townley, who spoke on "Salvage Corps"; Frank H. Jones, who spoke on "Actuarial, Inspection, and Audit Bureaus"; Richard E. Vernor, who spoke on "Fire Prevention and Fire Waste"; and P. R. Wesley, whose topic was "Qualifications of an Inspector."

The annual smoker proved to be a unique affair. Under the management of Charles Barger, the Theta Xi house was turned into a veritable gambling den. Guests furnished with bogus money followed the dictates of their desires to win more, at such games of chance as poker, bridge, roulette, lottery, and dice. Prizes were awarded the most successful gamesters.

The society was cheered to hear very favorable reports of Professor Finnegan's condition since his removal to an eastern hospital.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS

On March 25 the Armour branch of the A.I.E.E. staged its second smoker of the year in room D of the Mission. The evening really was a combination of high class entertainment and smoker. The entire program, dedicated to the Seniors, was provided by the Juniors under the direction of Mr. Hansen.

The program was opened with a violin duet by Robinson and Slugodzki. E. A. Larson played the piano accompaniment. The trio was well liked and had to play several encores. Stan Owens who played an important part in the last smoker, gave us a few readings from Rudyard Kipling. Bartucci then favored us with two classical numbers on the piano. What Desmond is to the Seniors, Bartucci is to the Juniors. "Nuff sed!"

The next number was rendered by the Junior Quartette: Lowden, Laederach, Lukey and Hansen. The first two men sang tenor and the last two, for variation, also sang tenor. The initial spasm was thirty-five verses from the "How Do You Do" song as applied to the various persons at the smoker. For an encore they gave us that famous illustrated song, "Ist Das Nicht Ein Garden House?"

The next selection was a saxophone duet by E. A. Larson and Goetz. By special request Stan Owens favored us with a repeat on Gunga Din. Eats were served and the card games started. At 11:30 it was necessary to close the activities, due to the shutting down of the power plant.

The Seniors take this opportunity to thank the Juniors for the wonderful send-off they have given us, and wish them sucess in handling the A.I.E.E. work next year.

AMERICAN INSTITUTE OF CHEMICAL ENGINEERS

Professor J. J. Schommer, in his attempt to fan into life the spark of intercollegiate competition, gave an interesting talk February 26 on "The Value of Competitive Athletics." A record crowd turned out.

March 19, Mr. W. B. Brown, Vice-President of the Victor Chemical Works, spoke on "The Uses of Phosphates in the Food Industries."

"The Everyday Possibilities of Chemical Engineering" was the enjoyable topic Mr. F. E. Gardner so ably lectured upon April 2.

HOME CONCERT

The twenty-fourth annual Home Concert of the Armour Tech Musical Clubs was held in the Mission on Friday, April 17. The fraternity banners and ferns which decorated the hall, together with the white flannels, created the proper atmosphere for the occasion. The program began at eight o'clock when the Band played the "Tenth Regiment March." The evening rolled on with pleasing selections from the Orchestra and Glee Club, intermingled with solos and novelties.

Mr. De Bourge was the first soloist on the program. He sang "Stonecracker John" and "Supposin'" in a deft manner. After the intermission Dean Monin invited the audience to see the Institute at work and at play on May 6 and May 9.

The "Electrical Sparks" played "My Best Girl," "Sally," and "All Alone" in a manner that caused the audience to call for more. The Senior Electricals are to be commended for their excellent work. The xylophone selections by Mr. Rezac stopped the concert and not until he had played three encores was he permitted to retire from the stage. He plays skillfully and is truly an artist. Following the string quartette, the Glee Club sang a comedy skit with Messrs. Coy, Tasker, Ericsson, and De Bourge in the leading roles.

The Band closed the program with selections from "Prince Charming" and "Superba." Just before the close of the concert Professor Phalen asked that the former members of the Musical Clubs in the audience come to the stage. Those present were Douglas, Friedman, and Schwartz. The fifty per cent who did not claim their tickets missed an enjoyable evening.

FRATERNITIES

TAU BETA PI

On April 30 the following Juniors were initiated into Beta chapter of Illinois:

E. J. Jaros
E. F. Johnson
S. J. McLaren
C. M. Nelson
E. G. Norrgard
H. J. Prebensen
D. R. Stiehl

In honor of these men and for an alumni reunion a banquet was held in the Fraternity Room of the Great Northern Hotel on May 2. The Senior members are making various plans for their careers following graduation, but most of them are going to take a month's vacation. Larson, Sothen, Odenwaldt, and Rowley are to join a Ford party that will tour the western states. Meyer will study language at the University of Chicago, thus preparing to enter Massachusetts Institute of Technology.

PI TAU SIGMA

Pi Tau Sigma at Armour has enjoyed a busy and prosperous season. On April 10 a smoker was held at which the following men were pledged:

A. J. Keating
H. C. Mueller
E. G. Norrgard
D. R. Stiehl
E. E. Wettley

Our informal initiation was held Saturday, April 18. The formal ceremony, on the afternoon of April 22, was followed by a banquet at the Webster Hotel.

The future of Delta chapter of Pi Tau Sigma depends upon the enthusiasm of the new members. The graduating members desire to publicly express their confidence in them and wish them success.

PHI LAMBDA UPSILON

A feature dinner party was given by Omicron chapter at the University Club, Saturday, April 25. The occasion was the welcoming into brotherhood the following men:

SENIOR
E. R. Geiger

JUNIORS
E. A. Armitt
W. J. Pollock

Our annual spring smoker was held in the chapter rooms, Tuesday, March 31. The presence of several alumni made the affair still more enjoyable. The members, because of their incessant noon-day practice, hereby issue a challenge to any honorary fraternity seeking the "500" championship.

SCARAB

To those men who have done exceptionally fine work in the Architectural Department, Scarab beckons. On this basis, the following men have been pledged to Scarab:

N. D. Barfield
J. P. Halama
V. Viscariello

The Scarab competition is now on exhibit at the Art Institute. The Scarab sketch exhibit will soon be here to be judged.

ETA KAPPA NU NOTES

The night of March 11 marked the beginning of a new era in the lives of five Juniors. It was the occasion of their acceptance of the pledge pins of Eta Kappa Nu, at a banquet held in their honor at the University Club. The banquet committee lived up to their past reputation and provided us a meal worthy of the occasion. After the chef had satisfied our inner cravings the after dinner speeches began. President Stemwedel acted as toastmaster, and most of the brothers are still wondering where he got his inexhaustible supply of jokes. And such speeches! They have never been equaled, even in Professor Scherger's class in public speaking. But the big surprise of the evening came when the "Discord Quartet," consisting of Larson, Tweedle, Taylor, and Bishop, tuned up the "uke" and gave us an enlightening, if not entirely musical, review of our failings in a "How Do You Do" song. Not one was missed. Even Professors Freeman and Snow, who were unable to be present on account of illness, were not forgotten. Brother Richardson then welcomed the new men on behalf of the Faculty, and to make the evening one long-remembered, the party departed *en masse* to the Chicago Theater. Our guests of the evening were:

W. A. Dean
A. S. Hansen
F. H. Le Cren
E. L. McHenry
G. A. Schaffer

After an extensive pledgehood, in which they were tried and thoroughly proven by action and examination, the pledges crossed the last obstacle on the night of April 21. The occasion was a joint meeting of Delta chapter and the Chicago Alumni chapter at the Hotel Brevoort. With the similar one held a year ago as a standard, the attendance was large, and a good time had by all.

The Inter-Honorary Fraternity Dance, held at the Ambassador Hotel on the twenty-fourth of last month, owes much of its huge success to Brother Larson who, as chairman of the committee in charge, gave his time unstintingly to put the dance over big.

When Commencement is over and the diploma framed, four Eta Kappa Nu men will fling in the last dunnage bag, strap that other valise on the running board, crank the trusty "flivver," and set out for parts unknown. The "four horsemen" are Sothen, Larson, Schroeder, and Stemwedel, and their destination is the wild and woolly West. May their trip be blessed with never the roar of a bursting tire or the wheeze of a missing cylinder.

Several of the fellows are already signed up for the summer. Earl Tweedle starts with the Electrograph Advertising Service on June 1. George Taylor is planning going to summer school at M.I.T. The rest of the fellows have been busy considering the various student courses offered by the different companies.

We had hoped to announce the winner of the Essay Contest in this issue, but at the time we go to press the decision has not been reached. The contest, which is open to all members of the Sophomore Class in Electrical Engineering, provides that the winner will be presented with a copy of the Standard Handbook. A large number of replies were received, making the choice of the winner a difficult one.

CHI EPSILON

Our chief interest during the current semester has been centered around the selection of candidates and their pledging to Chi Epsilon, honorary civil engineering fraternity. The men chosen were:

E. J. Jaros
E. H. Marhoefer, Jr.
G. O. Melby
C. M. Nelson
A. C. Rasmussen

As our most important function each semester is to properly discipline the pledges and prepare them for initiation, this matter was considered in detail. The candidates gave a good account of themselves and bore up well under their mops and buckets, providing that to-be-welcomed thing—a topic for local discussion and speculation.

Our initiation banquet was held at the University Club, Thursday evening, April 17. Many of the alumni members were present as well as members from other chapters, Robert M. Ford, assistant chief engineer of the Rock Island Lines, and Professor Roe L. Stevens of our own faculty were initiated as honorary members. The evening was one to be long remembered by all who attended.

SPHINX

On May 5 the members of Sphinx gathered together at the banquet table at the Lakota Hotel and honored the initiation of nine new members into their midst. The men initiated were:

SENIORS
E. R. Geiger
E. S. Larson
E. W. Odenwaldt

JUNIORS
N. D. Barfield
D. B. Davidson
W. E. Downes
H. C. Mueller
O. S. Peterson
N. C. Sanders

This initiation marks the close of a successful year for Sphinx. Under the guidance of Sphinx, the Press Club came into existence and it is the sincere hope of the graduating members that the spirit shown during the organization of this club will carry on.

PHI PI PHI

A good portion of the ultimate enjoyment is derived from the anticipation of an event. So it was with the cotillion held at the chapter house, March 21. A great many alumni were present and were unanimous in their desire to come again. The artistic decorations were so intermingled with serpentines, confetti and paper hats, that the house men will long rue the day after.

An alumni dinner on Sunday, March 29, brought many of the old boys back. 'Twas a jolly reunion sprinkled with the never-forgotten tales of long ago.

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ENGINEERING NEWS

The South Park Boulevard Viaduct

Prepared for THE ARMOUR ENGINEER

by Mr. T. L. Condon, of the firm of Condon & Post

The South Park Boulevard viaduct connects the north end of the extension of Grand Boulevard with the boulevard now under construction in the new park that is being made by reclaiming land east of the Illinois Central right-of-way at Twenty-third Street. Under the terms of the so-called Lake Front Improvement Ordinance, passed by the Chicago City Council on July 21, 1919, the right-of-way of the Illinois Central Railroad Company south of Roosevelt Road for a considerable distance was widened from a maximum of 200 feet to over 600 feet and at the site of this viaduct the new width of the right-of-way is 634 feet. The Illinois Central Railroad Company gave up its claims to riparian rights and permission was given to the South Park Commissioners to fill in the lake east of the widened right-of-way of the Illinois Central Railroad Company for park purposes.

At this time the South Park Commissioners are making a continuous park extending from Jackson Park on the south to Grant Park on the north. This new park area will be connected with the streets and boulevards on the west of the Illinois Central right-of-way by several viaducts, the first of which to be constructed is the one at Twenty-third Street.

According to the ordinance, this viaduct was to have a width of 100 feet and to have an inclined approach from the south on Grand Boulevard extended and another inclined approach from the northwest, diagonally across the block bounded by Twenty-second and Twenty-third Streets and South Park and Calumet Avenues, the main viaduct and the south approach to be built by the South Park Commissioners and the Northwest approach to be built by the Illinois Central Railroad Company on land acquired and furnished by the City of Chicago.

The ordinance fixed the elevation above lake level of the clearance line for the structure over the Illinois Central right-of-way, this clearance line being an inclined line with a uniform rise from the west side of the right-of-way of the railroad to a point 544 feet east, and horizontal from that point to the east edge of the Illinois Central right-of-way, the east end of the clearance line being 7 feet higher than the west end. The Commissioners planned to construct an artificial mound at the east end of the viaduct the top of which is to be 300 feet in diameter and 43 feet above lake level. When the work was started, the lake was from 15 feet to 20 feet deep where this mound is now located; in fact all but 200 feet of the main viaduct extends over what once was the lake and is now filled in.

The main viaduct consists of nine steel spans in three groups of three spans each. Each group of three spans consists of six continuous girders. The length of the girders in the east group is 167 feet 5 inches, the length of the girders in the center group is 289 feet 9 inches and the length of the girders in the west group is 177 feet 1 inch. The spans, beginning at the west abutment, are 30 feet 6 inches, 56 feet 3 inches and 79 feet 6 inches. The spans of the center group are 95 feet 7½ inches, 96 feet 3 inches and 95 feet 7½ inches, while the spans of the east group are 82 feet 3 inches, 60 feet 7 inches and 33 feet 1 inch. These span lengths are from center to center of column supports. The three groups are entirely separate from one another and there is a minimum clearance at normal temperatures of 3 inches between the adjacent ends of girders. The total length of the steelwork from face of abutment to face of abutment is 634 feet 3 inches.

At the meeting of the Armour branch of the Western Society of Engineers on Thursday, March 19, an illustrated talk, descriptive of the design and construction of the South Park Boulevard Viaduct now nearing completion, was given by Mr. Condron. This structure was designed by the firm of Condron & Post, Consulting Engineers, for the South Park Commissioners. Following the meeting, an inspection trip was made to the structure by members of the branch under the guidance of Mr. Condon.

When the work was visited on March 19, the concrete construction of the west plaza was completed and form-work stripped so that the general character and appearance of the structure could be seen. The west abutment was also completed with the exception of the Benedict stone embellishment, as was also a considerable portion of the reinforced concrete deck on the steel spans. Since that date the remainder of the concrete deck on the steel spans has been poured and all of the reinforced concrete structure of the east approach is finished as well as the east abutment.

The cover design is an interesting construction photograph, taken from the east end of the viaduct on April 11.

The foundations for the abutments and steel columns of the main viaduct are concrete cylinder piers, extending to bed rock, approximately 70 feet below lake level. The west ends of the west girders and the east ends of the east girders are rigidly anchored to an abutment pier and each girder passes over and is rigidly connected to two supporting columns, while the extreme end is carried on a rocker column, so that the temperature changes cause flexure in the intermediate columns, while the rocker columns give freedom of movement for the ends of the girders. Each of the center girders is rigidly connected to two intermediate colums, while the two ends of each center girder are supported on rocker columns, permitting freedom of movement of the ends of these girders for temperature changes.

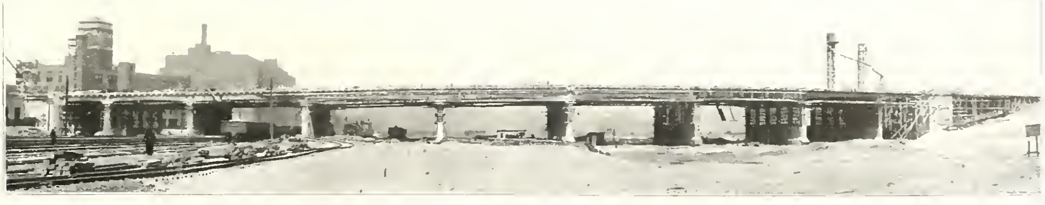
Some unusual details have been introduced into the design of these girders and their supporting columns and it is gratifying to record that, owing to care in design and excellent fabrication in the shop, these girders were erected and assembled in the field with perfect fitting.

While the girders are continuous for their entire length, it was necessary, of course, to provide field splices as the girders were too long to be transported in single lengths. These field splices were made at about the quarter points of the spans, and the maximum lengths of the girder parts for shipping were 106 feet 7 inches for the west group, 137 feet 6 inches for the center group and 113 feet 10 inches for the east group. The heaviest single piece of the center group weighs approximately 70 tons. These girders were raised in place from the ground and lowered into their column connections as the upper ends of the columns were formed into pockets to receive the girders which were rigidly connected to the columns by large numbers of rivets.

The steel structure described above carries a reinforced concrete deck 120 feet wide; for, while the ordinance called for a structure 100 feet wide, it was decided by the South Park Commissioners to adopt a width of 120 feet instead of 100 feet.

The outside girders are encased in poured concrete with ornamental treatment for appearance's sake. The supporting columns are all encased in poured concrete, but the steel girders and floor beams other than the outside girders are to be protected with gunite.

The east approach, connecting the end of the steel structure with the mound, is a reinforced concrete flat slab structure



The South Park Boulevard Viaduct from the south.

of two spans and a reinforced concrete retaining wall, the supporting columns of the flat slab structure and the retaining wall being carried on concrete cylinder piers extending to bed rock. The maximum length of these cylinder piers is 110 feet.

There is a large reinforced concrete plaza of flat slab construction connecting the two incline approaches with the west end of the steel structure. This plaza structure is about 350 feet long in the direction of the main axis of the viaduct with a maximum width of about 250 feet. It is supported on 142 columns and the maximum spans between the columns are 36 feet, these long spans being over the driveways of East Twenty-third Street and South Park Avenue.

Each of these supporting columns is carried on a group of composite piles of novel design. The piles for these column foundations extend down from 30 feet to 60 feet below Chicago datum (lake level). The plans and specifications provided for wood piles with a cutoff at 1 foot below datum but provided for the possible substitution of composite piles consisting of wood below datum and concrete above datum with the tops of the composite piles at or below elevation plus 9 feet. The type of pile that was finally approved and adopted consisted of a wood pile with a minimum top diameter of 13 inches to be driven until the penetration did not exceed 6 inches for 18 blows. These wood piles were driven through a steel shell 16 inches in diameter that had previously been driven to a depth of about 5 feet below datum.

After the wood pile was driven, a steel shell 14 inches in diameter, which had previously been covered with asphalt membrane waterproofing, was lowered inside of the driving shell and forced over the top of the wood pile for a distance of at least 30 inches, the wood pile top having previously been trimmed to a diameter of 13 inches to receive the steel shell. After the protected steel shell was in place, the shell was filled with grout and concrete. Then the 16-inch diameter driving case was removed while the 14-inch shell was held in place by the apparatus used.

The reason for substituting composite piles for wood piles was that the water level at this site was found to be about 7 feet above lake level, which would have necessitated driving tight sheeting through the water bearing sand for each separate foundation and involved a large amount of pumping in order to excavate down to datum to cut off the wood piles and build the concrete footings. By using composite piles with the tops of the latter all 7½ feet above datum, sheeting and pumping were eliminated, thus saving time and expense, notwithstanding the extra cost of the composite piles.

The entire surface of the decks of the approaches and the main viaduct is being waterproofed with an asphalt membrane waterproofing consisting of two-ply saturated cotton fabric and three moppings of asphalt. This waterproofing on the roadway is protected with a 2-inch thickness of concrete reinforced with wire mesh, over which will be laid an asphalt wearing surface.

The minimum width of the roadway will be 86 feet between curbs and the two concrete sidewalks will each be 17 feet wide over the main structure and east approach. The roadway over the west plaza is of irregular shape as are the sidewalks, these sidewalks varying in width from a minimum of 17 feet to more than 30 feet in places.

Around the west plaza and over the main viaduct there will be ornamental balustrades of Benedict stone and the same material will be used for the four ornamental pylons on the four ends of the two abutments. The faces of the projecting ends of the abutments will be veneered with ornamental Benedict stone. All along the outside edge of the sidewalks and beneath the balustrades there is to be an ornamental fascia of Benedict stone cast in place. All of the other Benedict stone will be precast and set in place. This Benedict stone will be similar to the Benedict stone that has been used for the exterior of the Grant Park Stadium, except that while that is white marble, the material used on the viaduct will have a granite finish.

This stone is now being cast in the new plant of the Benedict Stone Corporation just installed at Seventy-fourth Street and South Ashland Avenue, Chicago. The aggregates for this stone are shipped to Chicago from the Benedict Quarry at Tuckahoe, New York. The architectural features of this work were designed by Mr. Eugene C. Fisher, Consulting Architect, and the modeling of the ornamental details is now being done by Beil & Hermant, Sculptors, Chicago.

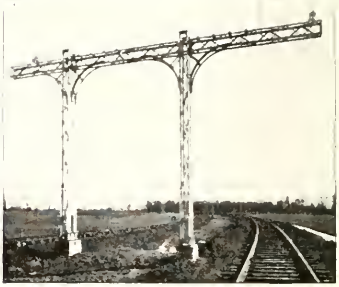
The main viaduct has a general ascending grade from the west, merging into a vertical curve beyond the center and descending toward the east end. The apex of the curve is approximately 50 feet above lake level or 7 feet higher than the surface of the east mound and about 19 feet higher than the low point of the west plaza. This gives a pleasing curve to the structure when seen from the north and south. The concrete encasing of the outside steel girders has been designed with flat curves for the lower chords, with curved fillets where these chords join the supporting columns.

Great attention has been given to the appearance of this structure because of its prominent location, with the wish to have it in harmony with the architectural features of the Stadium and the Field Museum, both of which are within sight of the viaduct. It is expected that the viaduct will be open for use sometime in June of this year and that the Benedict stone embellishment will be completed before the end of the summer.

The Niles Center Extension

In April, 1924, work was officially commenced on the Chicago, North Shore and Northern Railroad. This line was originally planned to connect the Howard Street station of the Chicago Rapid Transit Company with the main North Shore line at Waukegan by way of Niles Center north through the Skokie Valley. The object of this construction was twofold. It immediately provided dependable and frequent transportation service to the growing suburb of Niles Center, as well as transportation for the intermediate Skokie Valley region.

Due to the fact that it was necessary to obtain certain certificates and other documents and permits, the actual construction work was not started till May 8, 1924. The work was continued under the supervision of the Chicago, North Shore and Northern Railroad Company until October 6, 1924, when, by the consent of the stockholders, the road was consolidated with the North Shore Line. The construction was then carried on in a manner which confirmed with the principles and standards of the present North Shore Line. It was then decided that the work would be entirely completed to Niles Center before the northern portion through the Skokie Valley was begun. The immediate program called for five miles of double track, eight passenger stations, and one substation. This line was named the Niles Center Extension of the North Shore Line.



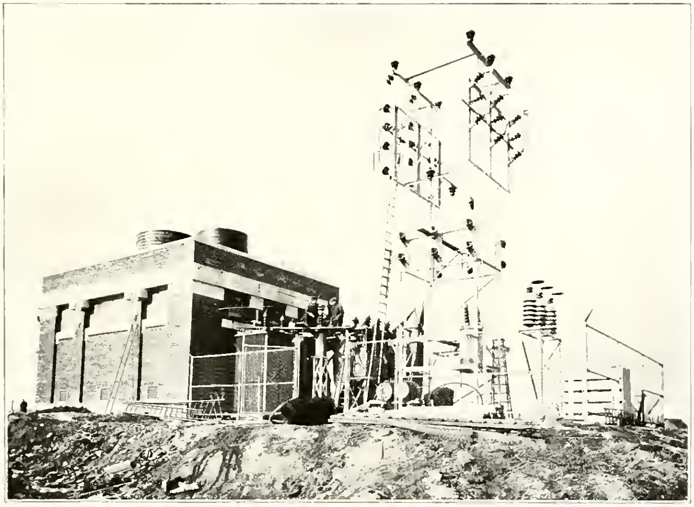
Courtesy the North Shore Line

Trolley supports are constructed from Bates Steel Expanded Sections. The feeder cable runs almost parallel to the tracks.

By October, 1924, more than a mile of permanent track had been laid west of the drainage canal where the road runs on the level. By working a force of men in night and day shifts, the subway under the Chicago and Northwestern Railroad at the eastern end was also well under way at that time. By December, 1924, six miles of track of the original ten miles to Niles Center had been laid. Seven of the eight stations were well under way. The structural work over the drainage canal was practically complete and the concrete for the Northwestern Railroad tunnel had all been poured. On February 1, 1925, the Niles Center Extension was officially opened. Regular service could have then been started at once if necessary; but since there was no pressing demand in the territory, it was deemed advisable to complete the work in every detail before operation of trains on a regular schedule was announced. Immediately afterward, through a track-leasing arrangement, the Chicago Rapid Transit Company agreed to provide the local service, for the present time, on the new railroad as far as Dempster Street, Niles Center. This is to be operated as a part of the Chicago Rapid Transit system. The regular schedule was made effective on March 28, 1925. Chicago Rapid Transit trains now operate at intervals of twelve minutes and make connections with the Evanston trains at Howard Street.

Less than ten months were actually required in the construction of this road. On account of the numerous difficulties not ordinarily encountered in railroad construction in a flat country, the record made in the building of this road is held to be a remarkable one. The new line runs in an open cut for some of its distance, on embankment for part of the way, and on the ground level for the remainder. In a great many instances the engineers were forced to make viaducts under streets and steam railroads—especially at the eastern end of the line within the city limits. In laying out the right of way, it was necessary to make a solid fill embankment for a considerable distance and also to construct an open steel trestle over the drainage canal and over the Mayfair cut-off of the Northwestern Railroad. A special sewerage system had to be laid to provide drainage and to keep the roadbed from flooding in times of excessive rains.

The construction of the project may be divided into three general groups; namely, stations, power supply, and roadbed. The stations were planned by the same architect who designed the Milwaukee, Kenosha, Wilson Avenue, and other stations of the North Shore Line. The stations are of different types, as some are placed beneath the surface, some on elevated structure and others on the level. At Ridge Avenue and at Asbury Avenue, the stations are built over the open cut in which the trains run, the station entrance being on the street level and the loading platforms underneath the stations in the subway. At Dodge Avenue the station is under the elevated structure, the platform being on top and between the tracks. The largest and most pretentious of the stations is at Dempster Street, Niles Center, which is the present terminal of the road. The building is a handsome structure with red tiled roof extending over the loading platforms. The interior contains a rest room for women, a smoking room for men, and is equipped with all modern conveniences. Ample parking space for automobiles is provided around the terminal.


Courtesy the North Shore Line

Automatic substation at Niles Center under construction.

The station buildings are of uniform design. The materials used in their construction are tapestry brick and granite terra cotta, with stone trimmings and tiled roofs. The interior is finished with art marble wainscoting and marble composition floors. The platforms are of cement with steel canopies. The stations have been designed with a view to permanency and economy in maintenance rather than saving in first costs. Although the territory to be served is sparsely settled at this time, there is no doubt that it will soon become one of the best suburbs on the North Shore. Building restrictions which have been agreed upon by all of the real estate subdividers in the territory will insure high class business and residence buildings, and the stations have been designed to add to the attractiveness of the community.

The power supply really consists of two separate problems; one of substation operation, and one of transmission. The power for this system will be supplied by two substations. The station now at Calvary will supply the east end, and the newly constructed one which is located at Niles Center on the Iserman Road will supply the west end. Stations similar to this new one will be provided for the continuation of the line to Waukegan in the future. This substation is entirely automatic in its operation, and is completely controlled by the chief load dispatcher, located in the Edison Building in Chicago. The station itself requires no attendants. It is, however, inspected once a week to ascertain that every detail is operating correctly. The station is a Westinghouse product and consists of one two thousand-kilowatt auto-rotary converter, transformers and the necessary automatic control equipment. The energy is purchased from the Illinois Public Service Company at 12,000 volts, 60 cycle alternating current, and is converted into 600 volts direct current for transmission.

The transmission of the power is accomplished by both third rail and trolley. Approximately three miles from Howard Street to Crawford Avenue operate on the third rail. This is similar to the ordinary Chicago Rapid Transit Company third rail system except that it is much heavier, eighty-pound rail being used. The balance, or remaining two miles, from Crawford Avenue to Dempster Street, is equipped with an overhead trolley of a special catenary construction. This construction was perfected on the test track of the General Electric Company, and is the first time it has been put into practical operation. Catenary trolley construction of this type permits the use of pantographs and allows safer and faster operation.

The supports for this trolley are placed from two hundred and fifty feet to three hundred feet apart. They consist of bridges constructed from Bates Steel Expanded Sections which rest upon concrete foundations. The metal parts are entirely galvanized to prevent oxidation and frequent painting. These sections are designed for side thrust only and depend upon cable supports at frequent intervals and line tension for support in the direction of the track. The trolley is made up of three separate wires. A primary messenger, consisting of one-inch diameter Copperweld cable, is first supported at the steel bridges. This cable takes the form of a catenary from which the name of the construction is derived. The ultimate strength of this cable is 55,000 pounds, and it is equivalent in conductance to a copper cable 600,000 circular mills in area. The cable is actually subjected to a tension of about 16,000 pounds. Supported from this messenger cable at frequent intervals and by links of varying lengths is the feeder cable. This construction results in the feeder running almost parallel to the tracks. This feeder cable is a bare copper wire of 500,000-circular mill area. From this feeder, the contact wire is hung by conductors of equal length. The interval between conductors is equal to half that of the feeder cable supports. The contact wire is a 0000 bronze alloy cable. This construction provides a flexible system that is rigid enough to prevent the pantograph or trolley wheel or shoe from jumping from the contact wire.

The steel trestle at the canal is similar to the present Chicago Rapid Transit construction. It is designed, however, for heavier loading. The balance is similar to ordinary steam railroad construction. The ballast for the latter portion has not as yet been completely laid; but since this does not materially affect the operation of the trains, it will not be completed until a later date. The track has a conductivity equivalent of 1,250,000 circular mills of copper.

The second section of the line will be laid through the Skokie Valley to a connection with the Libertyville branch of the North Shore Line to Lake Bluff where it is planned to carry the line north over the tracks of the present line at North Chicago to a junction with the main line at Valley Junction in North Chicago. It has not been definitely determined how soon this work will be started; but it will be in the immediate future.

New Potash Deposits in France

At Castagnede, in the Pyrenees district of southern France, there have been located potash deposits that are thought to be of considerable importance. Traces of petroleum were recently discovered in this locality.

The stratum is found at a depth of 550 feet, the vein of potash salts being approximately 280 feet thick. Analysis of boring at a depth of 650 feet, made by the Campredon laboratory at Nantes, showed 11.94 per cent of potassium chloride.

The deposit is considered as of a commercially workable nature, and plans for exploitation are under way.

Chemical and Metallurgical Engineering.

(Continued on page 156)

ATHLETICS

TRACK

It is a difficult process to build up a successful track team at a college where it has been dropped for several years. The men lack experience and, above all, they lack the inspiring influence of the companionship of winners. In spite of this handicap, however, the Armour relay teams, which competed in the relay carnival at Urbana on March 28, did credit to the college.

The two-mile medley team won fourth place in a field of seven. The runners were Payne, 880, Robinson, 440, long, 440, and Ball, mile. Each man was awarded a medal and they are on display in the trophy case.

The mile relay team consisting of Owens, Samuelson, Hoff, and Hamlett ran better than the existing record but were in a field that was so phenomenal that the record was broken by three seconds. As a result all the Armour team could get was fifth place. George Arton, director of the famous Pennsylvania relay carnival, saw the race and afterwards endeavored to get Coach Phalen to enter the Armour team in the Penn carnival. Although the team is good, it is not sufficiently so to warrant the expense and Armour cannot be represented in these events which attract teams from all parts of the country.

The track outlook for the outdoor season is good. Meets are scheduled with Crane College, St. Viator, Lake Forest, Carrol, and Y.M.C.A. College.

One thing that is arousing a good deal of interest is an all-around championship contest. Each contestant must be a member of the track team. Each contestant enters ten events and the contest runs through the season. Many of the forty-six members of the squad are expected to compete, particularly because of the division of the squad into two groups. The two divisions will be novice and varsity men. With this personal affair, along with the regular meets, the squad should remain intact throughout the season and keep the track events a permanent part of Armour's athletic schedule.

WRESTLING

The De Paul meet in our gymnasium was the best meet on the Armour program. De Paul, the Western Interstate champions of last year, had plenty of pep and speed but the Armour squad had the advantage and came out on top, 10 to 7. The Armour points were furnished by Janak and Green, each gaining a fall. Wiseman and Tiersky scored for De Paul with a fall and a decision, respectively.

At the end of the season, F. Payne was chosen for manager and Earl McHenry was elected captain.

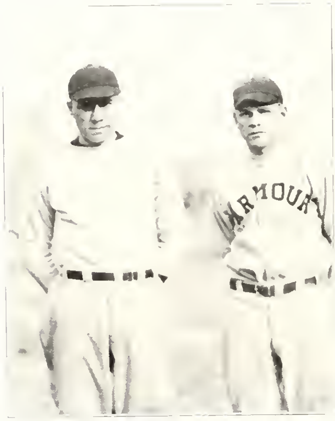
The summary of the De Paul meet follows:

De Paul at Armour

De Paul	Class	Armour	Winner
Wiseman	115	Schwartz	Draw
Wiseman	125	McHenry	D, fall
Wierzonowski	135	Janak	A, fall
Tiersky	145	Eisenberg	D, decision
Thorne	158	Green	A, fall
Grigsby	Heavyweight	Weisberg	Draw

BASEBALL

The baseball season opened with the teachers from Northern Illinois State Teachers' College handing the home team a 13 to 0 defeat. The game was ragged throughout and the only redeeming feature to the Armour team was the splendid work of Hofer. Besides getting a pair of hits he made some wonderful stops of wild pitches and looked like a real catcher even though it was the first game he had caught in an Armour uniform. When Hofer started catching, the vacancy left at first base was filled by "Red" Hellgren, whose basketball playing has made him known to all. "Red" looks good at first and ought to have little trouble holding the job.



Coach Kraft and Captain Burke.

The Michigan Aggies visited Ogden Field next and won fame for their star pitcher Wakefield who pitched a no-hit, no-run game and gave only two passes. His teammates gave him perfect support and kept the bases clear for most of the game. Only one Armour man reached third, and this was the result of a walk, a sacrifice bunt, and a sacrifice hit. Ruzich, doing the Armour hurling, had poor support and could not hold the score down. Thirteen hits and five errors accounted for the Aggies' score. The final count was 9 to 0.

The schedule does not contain many games as yet, but Manager Kovarick is trying to arrange a few more and the complete schedule should contain about twenty games. The schedule as arranged at present is:

April 14	N.I.S.T.C. at Armour,
April 16	Michigan Aggies at Armour,
April 21	Y.M.C.A. College at Y.M.C.A. College,
April 23	N.I.S.T.C. at DeKalb,
April 25	Lake Forest at Lake Forest
April 29	Lake Forest at Armour,
May 1	Western State Normal at Kalamazoo,
May 5	Y.M.C.A. College at Armour,
May 8	Western State Normal at Armour,
May 9	Alumni (Circus day),
May 13	Northwestern College at Naperville,
May 18	Columbia College at Dubuque,
May 20	Columbia College at Armour.

TENNIS

Coach Tibbals is well pleased with his squad this spring and expects to go through the long schedule without losing more than one or two meets. The men upon whom he depends are Captain Bishop, Castle, Peacock, Greenleaf, Taylor, Hammersly, Rhode, Jennings, and Weinberg. Some of them have been on the tennis team for at least one season and the remainder were discovered during the annual fall tennis tournament. All of them have had considerable experience and should furnish each other with enough competition to make the exact lineup uncertain throughout the season.

During the early part of the season it was difficult to arrange for home games because of the condition of the home courts but the courts are in shape now and there is plenty of room for spectators. The schedule as arranged by Manager Norton is:

April 17	Y.M.C.A. College at Armour,
April 23	Y.M.C.A. College at Y.M.C.A.,
April 25	Lake Forest at Lake Forest,
April 28	Wheaton College at Armour,
May 1	Northwestern College at Armour,
May 7	Lake Forest at Armour,
May 11	Marquette at Armour,
May 21	Wheaton College at Wheaton,
May 23	Marquette at Milwaukee.

SWIMMING

After steady practice under the guidance of Coach McGillivray the swimming team was prepared to win a few meets but they could find only two opponents, Y.M.C.A. and Kent Colleges. Manager A. K. Miller found a dearth of teams within the limited working radius of the swimming team and two meets with each of the teams mentioned above were all that he could arrange. After winning the first meet with "Y" College the squad prepared for the second, only to have "Y" College cancel it and thus cut the total number of meets down to three. That does not look like a schedule that would create much enthusiasm but nevertheless the men have been working hard and regularly. The lack of swimming teams in this district is unusual this season so that the outlook for next season is not quite so bad and a complete and successful schedule may be expected.

Brown was elected captain of the team after the resignation of E. Marhoefer.

The "Y" meet showed the necessity of a larger team. All of the Armour points came from firsts, except in the 40-yard breast stroke. The score should not have been as close as it was and would not have been, if a few more men had come out for the team.

The outstanding "Y" swimmer was Fern, but L. Marhoefer of Armour eclipsed everyone with his three decisive victories in the 40-, 100-, and 220-yard free style races. In each of these events he easily outdistanced his opponents and in the 220 he gained a lap. The relay team was composed of Brown, Lamm, T. Schuler, and L. Marhoefer. Following is a summary of the "Y" meet:

Armour (33) "Y" College (26)

Event	First	Second	Third
Relay	"Y" College	Armour	
Diving	Brown (A)	Fern (Y)	Wilt (Y)
40-yard free style	L. Marhoefer (A)	Lagatan (Y)	Wilt (Y)
40-yard breast	R. Schuler (A)	Sargent (A)	Lagatan (Y)
220-yard free	L. Marhoefer (A)	Fern (Y)	Benninghoff (Y)
Plunge	DeBourge (A)	Wilt (Y)	Prosser (Y)
100-yard free	L. Marhoefer (A)	Fern (Y)	Prosser (Y)

Phi Pi Phi basketball team—interfraternity champions.
Back row—Johnson, Peterson, Lowden, Jennings, H. Burke, Kuffel.
Front row—Hall, Morgan, Downes, L. Burke, Pate.

BASKETBALL

The basketball team had a lot of tough breaks in the last few games and lost most of them by one or two baskets.

The scores not published in the last issue of The Armour Engineer were:

Armour, 13; U. of Detroit, 15.
Armour, 23; St. Mary's College, 25.
Armour, 27; Western State Normal, 31.
Armour, 32; Marquette, 16.
Armour, 13; Marquette, 20.
Armour, 18; N.I.S.T.C., 24.
Armour, 33; Chicago Tech, 13.

The following summary shows the results of the team and of the individuals:

Games	Won	Lost	Percentage
17	6	11	0.353

Individual Records

	Position	Games	Field Goals	Free Throws	Fouls	Points
McLaren (Capt.)	F	16	54	23	23	131
Hellgren	F	10	33	9	5	75
Danziger	F	17	27	11	18	65
Petersen	F	10	1	3	3	5
Brockman	C	17	17	8	16	42
Gaylord	C	16	5	1	4	11
Augustine	G	17	8	13	25	29
Morgan	G	16	4	4	8	12
Weinwurm	G	17	2	2	23	6
Kuffel	G	11	0	2	10	2
Totals			151	76	135	378
Opponents						405

INTER-FRATERNITY BASKETBALL

After one of the most bitterly contested tournaments in the history of Armour Tech, Phi Pi Phi was crowned interfraternity basketball champion for the fourth consecutive year.

Instead of the usual elimination scheme, the tournament was run off on a round-robin schedule. The fraternities were divided up into two groups and the winners in each section played for the championship. Group "A" consisted of Theta Xi, Triangle, Delta Tau Delta, and Phi Pi Phi. Group "B" included Sigma Kappa Delta, Phi Kappa Sigma, Rho Delta Rho, and the Umen. Beta Psi and Sigma Alpha Mu did not enter teams.

Group "A" competition soon developed into a struggle between the ancient rivals, Delta Tau Delta and Phi Pi Phi. The Phi Pi team staged a comeback and trimmed the Delts in a playoff for the sectional title by a 21 to 13 score. The playoff was necessary, due to the fact that each team had been upset once—the Delts by Theta Xi, 9 to 7, and Phi Pi Phi by the Delts, 7 to 6.

In group "B", Phi Kappa Sigma proved to be the upset of the tournament. At the beginning the "dopesters" didn't concede the Phi Kaps a chance, but "dope" doesn't win games. These boys battled from start to finish and as a result won the Group "B" championship by beating Sigma Kappa Delta in the final game of their division.

The two divisional winners, Phi Pi Phi and Phi Kappa Sigma, met for first honors in the final and Phi Pi Phi copped, 31 to 15. The short passing game of the Phi Pi machine was well oiled on this occasion and, although the Phi Kaps put up their usual fight, they were no match for the winners. This last win gave Phi Pi Phi possession of the first leg on the new trophy which was "floated" this year.

FRATERNITIES

(Continued from page 141)

The Easter tea dance, Sunday, April 12, was a great success despite the traditional display of Easter finery.

A novel feature of Open House Night, May 6, was the entertainment provided for our guests. Everybody had a good time and many were the wishes of the old grads to again lead the carefree life of an Armour student.

Our social year was closed by a most successful climax in the form of a farewell dinner dance at the Edgewater Beach Hotel, May 22, in honor of our departing seniors.

The following men have been added to the fraternity roster:

K. C. Anderson
R. N. Brown
H. J. Burke
L. Marhoefer
R. N. McFerran
T. Samuelson

The chapter takes pleasure in announcing the pledging of C. F. Jillson, E. B. Kapke, and A. C. Lindeberg.

THETA XI

The human side of the professors who attempt to scratch the surface of our intellect was ably demonstrated at the annual Faculty smoker on March 20. A Bridge and "500" tournament was held in which our honored guests annexed both titles.

Our anniversary entertainment was held April 25 and attended by a large gathering of old timers who entertained us long and well with tales of bygone days. A novel wrestling bout was provided by Brothers Hatch, Barger, Eckhart and St. Clair. The music furnished by Brothers Harris and Higgins proved to be an outstanding memory of that never-to-be-forgotten celebration.

The Theta Xi picnic was held the end of Junior Week, May 10.

Alpha Gamma of Theta Xi wishes you the best of luck on your finals and a most pleasant summer.

(Continued on page 158)

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WILL BE SENT ON APPLICATION

TRANSMITTING EQUIPMENT

FOR RADIO TELEPHONE BROADCASTING

(Continued from page 133)

Meters are provided in the antenna and closed oscillatory circuits, in the oscillator plate and grid circuits, and in the modulator plate and grid circuits. When the equipment is in operation, the needle of the modulator plate meter swings at syllable frequency and affords a convenient, although somewhat rough, means of adjusting the input amplifier to give the proper volume level. The function of the meter in the grid circuit of the modulator is to serve as an "overload" indicator. Overloading has already been mentioned and its causes briefly discussed. In the equipment as designed, it is occasioned by the peak signal voltage impressed upon the modulator grid exceeding the polarizing voltage in the positive direction. When this occurs a momentary current will flow from the grid to the filament and the meter will give an indication. The operator is, therefore, afforded a positive means of detecting overloading and a definite operating procedure may be worked out to insure best results.

The three dials shown control the antenna tuning, the frequency, and the oscillator adjustment respectively. The first is associated with the antenna tuning coil shown in the top of the set behind the tubes. The second operates upon the oscillator coil, which appears near the center of the rear view and serves to vary the inductance of the winding in the oscillatory circuit. The oscillator adjustment control is connected with a variable air condenser joined in parallel with the plate coil as previously described.

The condensers in the radio frequency circuits appear below the oscillator coil. The audio frequency coils and condensers are mounted under the tube compartment and in the bottom of the unit behind the resistance unit assembly.

The power apparatus for the radio transmitter is shown in the lower right-hand corner of Figure 4. The motor-generator consists of three units mounted on a fabricated base; a suitable motor, a 1600-volt, 1.25-ampere generator, and a 16-volt, 30-ampere generator. The high voltage generator is constructed with two 800-volt armature windings and employs two commutators. Current for the field is obtained from the low voltage unit which is self excited.

The power panel is of the cabinet type. It includes a suitable motor starter which is controlled from a push-button station on the panel and on the operator's desk, field rheostats and voltmeters for each generator, an electromagnetically operated switch in the plate circuit which also serves as a circuit breaker, and rotary snap switches in the filament and high voltage field circuits. No live metal parts are exposed on the panel and, as further protection to the operator, a door switch is provided which prevents the motor from being started until the door of the cabinet is closed.

The radio receiver, which also appears in Figure 4, consists of a detector and two stages of audio frequency amplification utilizing tubes similar to the VT-1. Coupled radio frequency circuits are employed without regeneration. Suitable jacks are provided permitting the detector to be used alone or in combination with one or both of the amplifier stages as required. Power for the filament and plate circuits is obtained from the batteries that supply the speech input equipment.

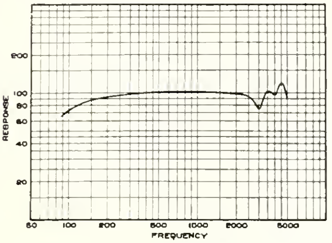

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Figure 5.

Over-all frequency-response characteristic of the 500-watt broadcasting equipment.

On account of the severe transmission requirements imposed upon this class of apparatus, the performance capabilities of the equipment, especially its frequency-transmission characteristic, will probably be of considerable interest. The characteristic for the equipment when employing the carbon transmitter is shown in Figure 5. This curve is a composite based upon single frequency measurements made on the individual apparatus units. It may be considered to represent the relative magnitudes at the various frequencies of the effective alternating component in a suitable rectifier circuit coupled to the antenna when the sound pressure impressed upon the diaphragm of the transmitter is maintained constant. In other words, if the effects of standing waves and other purely acoustical phenomena are eliminated, and if a pure tone of constant intensity but variable pitch is produced in the studio, this curve represents the relative intensity of the sound which might be expected from a distortionless receiving device. Logarithmic scales are employed for both ordinates and abscissae since there is considerable evidence to indicate that the response of the ear to variations in both intensity and pitch follows a logarithmic law. As will be noted, substantially uniform transmission efficiency is indicated except at the extreme ends of the frequency range where some slight deficiencies become evident. These can be detected only by careful measurement, however, and it is doubtful if their effect upon transmitted music would be apparent even to the artistically trained ear.

The general considerations involved in the design of a system for the high quality transmission of speech and music have been mentioned briefly, and the requirements to be met by the various apparatus units in a radio telephone broadcasting equipment have been discussed in some detail. A commercial 500-watt transmitting equipment has been described and its performance capabilities illustrated. It has been shown that apparatus can be produced commercially which will afford transmission at substantially uniform efficiency throughout the entire frequency range commonly employed in music.

From a quality point of view, at least, therefore, transmitting equipment for broadcasting applications may be said to have already reached an advanced stage of development. A standard of performance has been attained which it is not believed presumptuous to claim is an artistic as well as a technical success. The next few years will no doubt bring forth contributions of great value—new and more efficient telephone transmitters, better vacuum tubes, more stable circuits, and less expensive apparatus—but in view of present attainments, radical improvement in the quality of the transmission can hardly be expected. If further improvement in quality is desired by the listener, it must be attained elsewhere than in the transmitting equipment.

"Transmitting Equipment for Radio Telephone Broadcasting" is the most interesting part of a paper presented by Mr. Nelson before the Institute of Radio Engineers.

Blessed is he who found his work; let him ask no other blessedness. He has a work, a life purpose; he has found it and will follow it.—*Carlyle*

THE WORK OF THE FOREST PRODUCTS LABORATORY

(Continued from page 130)

largely to the intelligent interest and cooperation of the paper industry. Investigations of the fundamentals of the groundwood process have been completed and similar studies of the chemical processes and of bleaching are being prosecuted. Because of the depletion of spruce and of the relatively few additional woods used at present to furnish most of our supplies, the effort now is to develop processes for making newsprint and book paper from so-called inferior species and from other vegetable fibers. A satisfactory book paper has been made from ailanthus, a tree which has become a pest in certain parts of the country because of its heavy seeding qualities and rapid growth and because of the lack of commercial uses for its wood. This tree reaches pulpwood size in from 10 to 15 years, and as compared with aspen it yields considerably more pulp per cord and has a trifle longer fiber.

An improved process for using aspen has been investigated. Heretofore, because of the shortness of the aspen fiber, it has been necessary to mix long-fibered coniferous stock with it to produce book paper of good strength and quality. By means of the new process 100 per cent aspen may be used, thus relieving a part of the drain on spruce, hemlock, and other conifers.

Another process offers even greater relief to the spruce stands in that it aims to utilize hardwoods for the production of newsprint. By this process nine-tenths of a cord of black gum has been made to yield a ton of pulp, whereas 1.2 cords of spruce are required to produce the same amount of spruce groundwood. Similar satisfactory results have been obtained with tupelo gum and the high quality of the pulp gives promise that such broadleaf woods as birch, beech, maple, aspen, and cottonwood may also be used to produce newsprint. The development of this project is important both as it affects the spruce situation and as it affects the hardwood forests of the South.

More than 4 billion board feet of lumber, or about one-sixth of the total annual cut, are used for boxes and crates for shipping purposes. A considerable part of this lumber is wasted through the use of excess lumber in containers, and in addition to the loss from this cause millions of dollars more are lost every year through loss or damage of the goods shipped in defective containers and through extra freight paid on the extra lumber. To assist shippers in improving the design of containers so as to obtain adequate strength with a minimum of lumber the Forest Products Laboratory operates a well equipped section of container investigations. Besides a complement of machines for compression tests on the ends, sides, and along diagonal axes of boxes, this section operates two box tumbling drums and a vibration machine which were designed especially for box testing purposes by means of the staff.

The larger drum has a diameter of 14 feet, the interior surface being hexagonal. In testing boxes the drum is rotated at the rate of one revolution per minute so that a box under test in the drum jolts against the six faces in succession and against an arrangement of baffles and projections. Boxes up to 4 feet in dimension and a half ton in weight receive in this machine in a few minutes practically the same punishment that they would undergo in a thousand-mile journey. The smaller drum, really the predecessor of the larger one, has a diameter of 7 feet and is used for tests on small wooden boxes and fiber containers. The vibration machine consists of a platform which weaves back and forth and subjects boxes fastened to it to a strain similar to that received in a freight car in transit.

A typical case in which the laboratory redesigned a container to the advantage of the shipper and to the cause of timber conservation involved a crate for shipping steel pulleys. As compared with the crate used by the pulley manufacturer the scientifically made crate required 13.5 per cent less lumber in its construction and one-third less steel strapping. It weighed 5 per cent less, required a trifle less shipping space, and withstood 100 drops in the box testing drum without failure. The manufacturer's crate broke open with the first crash in the drum.

Fundamental data in the structure of wood as revealed by the microscope serve as the basis for the identification of wood by examination of the wood itself rather than by an examination of the botanical characteristics of the tree. A microscopic study of wood also helps in explaining some of the phenomena related to the properties of wood. Studies are now being made on the cause of variation in shrinkage, on brashness, and on the response of the wood of living pine trees to tapping for turpentine. Authentic specimens of most of the trees native to this country and of numerous foreign species have been collected and microscopic slides and photomicrographs made showing radial, transverse, and tangential sections. These have been analyzed and a key worked out by which it is possible to distinguish most of the commercial species by structure alone. In addition to routine identifications of wood specimens for fellow members of the staff, many wood samples submitted by private concerns and individuals come to this office for identification. In the capacity of wood technologist the laboratory has acted as arbiter in a number of cases in which the species of wood has been disputed by purchasers of lumber, sawdust, manufactured articles, and other forms of wood.

One way in which the laboratory makes its findings available to the wood-using industries is by means of short intensive courses of study in kiln drying, wood properties and uses, boxing and crating, and the gluing of wood. The courses are offered by the laboratory several times a year under the instruction of members of the staff, and they have been attended by representatives from a wide range of industries.

In the future the work of the Forest Products Laboratory should be greatly stimulated by the increasing shortage of timber, and it is well equipped to play an increasingly active part in timber conservation affairs. Thus far in its history there has been little if any apparent feeling that its activities are in the nature of "government interference in business," and the laboratory expects to retain the good will of industry. It is already too late to assure the generation of fifty years hence an adequate supply of wood, even on the basis of intensive reforestation started now, if we continue present slack methods of utilization. It is expected that as the coming timber famine is felt more generally, utilization refinements practiced now only by progressive minorities or neglected entirely will be put to use and that the wood utilization research man will offer his results in a seller's market.

Moving a Live Transmission Line

An Ohio public service company recently succeeded in digging up and resetting in a new location the poles of a transmission line, without interrupting the load. While the poles were being moved, the lines were carrying a lighting load at 13,000 volts.

The line parallels a state highway, and preparation for widening the road necessitated the moving of the transmission line ten feet. The line is six miles long and is supported by about 160 poles. Each pole was gently picked up by a crane and lowered into a freshly dug hole very carefully. The crane was mounted on a motor truck and traveled up the line, transferring the 160 poles in a single day. No accident was encountered or disturbance in load conditions noted at the power house.

Power Plant Engineering.

BETTER LIGHTING NEEDED IN INDUSTRIAL PLANTS.

In a paper read before the Illuminating Engineering Society, February, 1920, entitled, "A Survey of Industrial Lighting in Fifteen States," R. O. Eastman submitted some very interesting data regarding the lighting conditions in industrial institutions. The survey comprises some 446 institutions, in which lighting was considered by 55.4% as being vitally important, and by 31.6% as being moderately important, and by 13% as being of little importance. Practically 58% considered that lighting was as important as power in the operation of the plant, and a small proportion would give more attention to lighting than to anything else.

In considering the present condition of lighting as found in the various plants, only 9% ranked as excellent, about ⅓ ranked as good, 29% fair, 18.8% poor, 3.5% very poor, and 7.8% partly good and partly poor. It was found that the lighting in the offices was far superior to that in the shops; 19% being excellent, 36% good, 31% fair, and only 13% poor and none very poor.

On consulting the executives regarding what factors were most important in considering lighting, the following facts were revealed: Increase of production 79.4%, decrease of spoilage 71.1%, prevention of accidents 59.5%, improvement of good discipline 51.2%, and improvement of hygienic conditions 41.4%. Manufacturers who have good lighting appreciated its value largely from the standpoint of its stimulating effect upon output.

There is no question that any intelligent man who carefully considers the necessity for good lighting in an industrial plant, will agree that it is impossible for a person to do as good work, either in quality or quantity, in poor light as in good light, but yet the result of a careful analysis discloses the fact that only about 40% of industrial plants are furnishing good light to their workers and 60% are operating under poor lighting. It is hard to understand why such a proportion of concerns can be satisfied with a condition which is universally admitted to be a curtailer of efficiency and a prolific causer of accidents. The principal cause of this condition is that those in charge of such establishments have not given the attention to lighting that it demands. They do not know what constitutes good lighting, and in their absorbing interest of other factors of production have overlooked a vital one.

Every safety official should deeply interest himself in the lighting of his plant and insist upon good lighting as much as good goggles, good guards and other necessary accident prevention equipment. Every production manager should insist upon good lighting because the efficiency of the working force is increased by the condition of the lighting furnished. The plant physician should examine the lighting, for eye strain and eye fatigue are directly affected by poor lighting, as is the hygienic condition. Well lighted plants are invariably cleaner than poor lighted places. Plants equipped with Factrolite Glass in all windows are well lighted.

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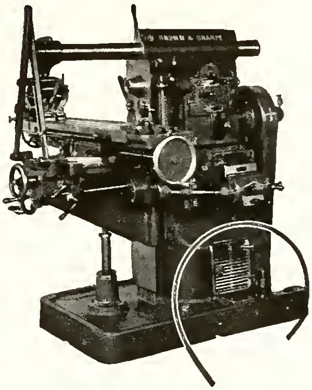

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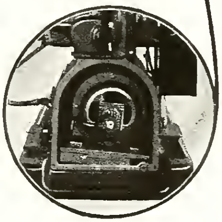

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COLLEGE NOTES

(Continued from page 142)

Dr. Wilson L. Miser, associate professor of Mathematics, has been appointed Professor of Mathematics at Vanderbilt University, Nashville, Tennessee. He will take up his new duties in the fall. The many friends Dr. Miser has made in the six years he has been at Armour will be sorry to see him go.

THE JUNIOR FORMAL

The annual Junior Prom was held at the Belden-Stratford Hotel on May 8, the evening preceding Circus day. More than one hundred couples found in the music of Hank Harris, a member of the Junior Class, the floor, and the novel programs the correct proportions of the proper ingredients for a perfect evening. The grand march, which formed in two wings of the ballroom, was led by A. J. Danziger, president of the Junior Class and D. B. Davidson, chairman of the social committee, with their fair partners. The fortune which smiled upon the Juniors was due largely to the efforts of the energetic social chairman and his committee.

Mr. C. J. Hoague, manager of the West Coast Forest Products Bureau, gave an illustrated lecture on "Logging and Lumbering in the Pacific Northwest and Japan" on February 27.

On March 6 we spent a delightful hour with Colonel Philip A. Moore and "Trail Riding in the Rockies." The lecture was illustrated with slides and motion pictures.

On Friday, March 13, Mr. E. L. Des Jardins presented "The Story of Continental Motors" in motion pictures. The steps in the manufacture and operation of the famous Red Seal motor were depicted in a progressive trip through the factory of the Continental Motors Company. Locally, the film was of especial pertinence, for the first Continental motor was built in the laboratories of the Armour Institute of Technology in 1902 by Mr. R. W. Judson, now president of the company.

SCHOLASTIC STANDINGS

The following statistics, compiled by the Office of the Dean, give the scholastic standings of the members of the Freshman, Sophomore, Junior, and Senior Classes of the College of Engineering and Architecture who were in attendance during the first semester of the college year 1924-1925. In this computation the grades in Physical Training were omitted. A credit (Cr.), either for work at the Armour Institute of Technology, or for work elsewhere was considered equivalent to a grade of "B."

The average of the entire college body, a total of 696 students, is 85.7 per cent.

The averages of the various organizations are as follows:

The Senior Class	88.0
The Junior Class	87.5
The Sophomore Class	85.4
The Freshman Class	83.6

The student with the highest average in the Senior Class is Mr. Milton F. Adair. His average is 95.0.

The student with the highest average in the Junior Class is Mr. Arthur S. Hansen. His average is 96.5.

The student with the highest average in the Sophomore Class is Mr. I. B. Lehman. His average is 95.4.

The students with the highest average in the Freshman Class are Mr. L. J. Anderson and Mr. E. C. Bacot. The average of each is 95.9.

Mechanical Engineering Department	86.3
Electrical Engineering Department	85.9
Civil Engineering Department	84.1
Chemical Engineering Department	87.6
Fire Protection Engineering Department	86.2
Architectural Department	84.7

THE HONORARY FRATERNITIES

Tau Beta Pi	91.9
Eta Kappa Nu	90.6
Scarab	85.2
Phi Lambda Upsilon	91.2
Salamander	91.4
Chi Epsilon	89.9
Pi Tau Sigma	90.9

SOCIAL FRATERNITIES

Phi Kappa Sigma	86.0
Delta Tau Delta	86.4
Theta Xi	84.8
Sigma Kappa Delta	87.3
Phi Pi Phi	86.5
Triangle	87.3
Sigma Alpha Mu	86.6
Rho Delta Rho	87.0
Beta Psi	87.2

CLUBS

Sphinx	90.0
The Truss	87.1

The average of all students belonging to the Phi Kappa Sigma, Delta Tau Delta, Theta Xi, Sigma Kappa Delta, Phi Pi Phi, Triangle, and Beta Psi fraternities (fraternities that rent or own their own chapter houses) is 86.2.

The average of all other students is 85.5.

In the computation of averages the following numerical values were given to the letter grades:

A	97.5
B	90.0
C	80.0
D	67.5
E	50.0
Cr.	90.0

Registration Second Semester 1924-1925

	Seniors	Juniors	Sophomores	Freshmen	Specials	Total
Mechanicals	33	24	35	38	..	130
Electricals	32	32	56	53	2	175
Civils	13	25	31	44	..	113
Chemicals	21	19	20	13	..	73
Fire Protects	20	22	27	33	..	102
Architects	15	20	22	43	1	101
Total	134	142	191	224	3	694

POETRY AND SLIDE RULES

(Continued from page 141)

or, let us say, that the mysteries of differentiation were revealed in sonnets, free verse, or even music. Who will say that such a thing cannot be done? And who will say that this dual instruction will not be of benefit in the case of *both* subjects? An approach to this plan is made at present in the courses in English composition. Undoubtedly, writing improves the student's knowledge of the technical subject which he may be discussing. On the other hand, extensive and orderly knowledge of the subject improves his composition—for coherent writing must be a succession of related thoughts. Similar mutual benefit may be expected from an extension of this idea to other courses which are or which might be included within the curriculum.

THE MONEY VALUE OF EDUCATION

As engineers, we are repeatedly told that service to mankind is the only ambition in life to which we may lay claim without blushing. Nevertheless, it is reassuring to the mercenary side of our nature—and, in the interest of truth, the appreciation of money still exists to a marked degree—to reflect that, as a dividend-paying investment, an education ranks high. The actual cash value of secondary and higher education is revealed in a set of statistics recently issued by Dean Everett W. Lord of the College of Business Administration, Boston University. These facts are shown:

"The *untrained man* goes to work as a boy of 14 and reaches his maximum income at 30, on the average of less than $1200 a year. Since his income is largely dependent upon physical strength and manual dexterity, it falls off at 50 or earlier, to a point below the level of self support. More than 60 out of every 100 untrained workers are dependent upon others for support at the age of 60.

"The total earnings from 14 to 60 are about $45,000. Not more than $2000 is earned in the four years that would have given him a high school education.

"The *high school graduate* goes to work at 18, passes the maximum earnings of the untrained man within seven years, rises steadily to his own maximum of approximately $2200 at 40, and continues at that level for the remainder of his active life.

"His total earnings from 18 to 60 are about $78,000. The $33,000 more than that earned by the untrained man represents the cash value of a four-year high school course.

"The *college or technical school graduate* begins his permanent earnings at 22, although a considerable amount may be earned during the college course. By the time he is 28, his income equals that of the high school graduate at 40, and it continues steadily to rise, practically without a break.

"Since his income is dependent upon his mental ability and training constantly improved by practice, it increases instead of diminishes with the years. The average of $6000 at 60 is often surpassed.

"His total earnings from 22 to 60 (not including anything earned during the college period) are $150,000. The $72,000 more than that earned by the high school graduate represents the cash value of college and technical training."

(Continued on page 156)

But the whole team doesn't play first base

To suppose that a baseball nine will all cover just one position is as far from the truth as to think that everyone in the electrical industry is an engineer.

This field will always need trained engineers. But with its great manufacturing, construction and commercial activities, the industry must have non-technical men too.

Since the industry is manned by many types, the result of your work will depend a good deal on the success with which you team up. The qualities that win are not only efficiency attained by the light of a study lamp, but that all-pull-together spirit of the athletic field.

This point of view may be useful to the man who has wondered whether campus activities, with all their striving and stern testing, their setbacks and their triumphs, have any counterpart in after life.

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THE NEW HOLY TRINITY CHURCH

(Continued from page 138)

of a part of the front wall to create space for offices and a reception room. The use of hanging rods from the trusses as a means of support for the balcony was not allowed by the architect.

The section of the balcony between the towers is projected out to cover the platform of the entrance stairway. It is held by a steel frame system of **I**-beams, spanning between the steel, stone-encased columns at the front of the platform and between the columns and a concrete girder at the rear.

All floor construction is of the ribbed-slab type. The girders are of reinforced concrete with the exception of the two girders supporting the columns carrying the balcony and a third girder for which steel was used to save necessary space.

The walls are of brick with some stone veneering, and are carried to the grade line where the concrete wall starts. Since the basement floor is 9 feet below grade, the foundations are carried as deep as 12 feet 10 inches below ground level. The towers are carried to a height of 101 feet above grade and carry at the top small domes, 16 feet in diameter. The domes are to be covered with copper tile—the same as the roof. A large illuminated cross is to be placed at the top of the large central dome.

The work will be let to a general contractor and construction will start in the near future. The estimated cost of the building is placed at a quarter of a million dollars. The greater part of the expense will be covered by a building fund which the church now has, and by subscriptions of its members.

THE MONEY VALUE OF EDUCATION

(Continued from page 154)

These figures may serve to hush the fears of the pessimistic senior, to whom a wage will soon be a very important reality. More significant is the possible effect upon the high school graduate who might be attracted away from college by a seemingly lucrative position in business or industry. While the high school graduate possesses an enormous advantage over the untrained man, this gain is totally eclipsed by the cash value of college training.

Dean Lord's statistics invest the college senior with a new importance. Society expects to reap profits from the investment it has made in higher education. The colleges and universities of the nation may well bring closer scrutiny than ever before upon the finished product.

The quoted matter above has been abstracted from a bulletin. "Inequalities in Educational Opportunities in Illinois," issued by the Superintendent of Public Instruction.

ENGINEERING NEWS

(Continued from page 147)

Fuel Flowmeter Works on Intermittent Weighing Principle

A machine for determining the rate of flow of gasoline or other liquids, in pounds per hour, has been designed by Professor Daniel Roesch of Armour Institute of Technology and is being built by the Gaertner Scientific Corporation of Chicago. This machine does away with the well known difficulties of viscosity changes present in volumetric flowmeters. This machine is described in a recent number of *Automotive Industries.*

The weighing mechanism includes a sensitive beam scale mounted on knife edges. On the right arm of this scale is hung a glass container, which supplies gasoline to the machine to be tested. On the left arm of the beam scales is hung a counterweight. The glass container is intermittently supplied with fuel from the copper reservoir on the top of the machine. The reservoir has two compartments, so that two kinds of fuel are available by manipulation of the proper stopcocks. The glass container is automatically held at nearly an even balance by a solenoid-operated valve which intermittently supplies fuel from the main reservoir.

With the master control switch thrown to the right, this intermittent feed to the glass container will continue as long as the engine uses fuel. Tests can be started at any time the valve is not supplying fuel to the glass container, that is, when the side of the latter is heavy. The test is started by throwing the master switch to the left. As the glass container becomes lighter it will rise to an even balance with the counterweight and close the mercury contact near the lower part of the center post of the beam scale. This is a double insulated contact, made with a platinum point in mercury, and is arranged so that it can be oil sealed when highly volatile fuels are used. This contact carries the primary current of a relay, about one-tenth ampere. The secondary of the relay starts the stop watch.

At any time after the watch is started and before the end of the run, the desired weight is added to the pan under the glass container. This makes the right side of the beam go down and it remains down till the weight of fuel equal to the selected test weight is used by the engine. A second rising of the glass container again operates the platinum-mercury contact and stops the watch. This records the time necessary to use the selected weight of fuel. The revolution counter on the dynamometer is automatically engaged during the fuel test run. The readiness to test feature is a great convenience for the operator since the machine is automatically held ready for a test run.

Three of the machines have been in use in the Automotive Laboratories of Armour Institute of Technology for a number of years, and the Yellow Sleeve Valve Engine Works have two of the machines in their East Moline testing laboratory.

$7,000,000 Worth of Whistling

Prof. Arthur L. Foley of the University of Indiana has calculated that 2,434,026 tons of coal, costing $7,302,078, are consumed annually in the United States in generating steam to blow locomotive whistles. He maintains that two-thirds of this coal could be saved by higher-pitched whistles placed further forward on the steam locomotive.

Talents are best nurtured in solitude; character is best formed in the stormy billows of the world.—*Goethe.*

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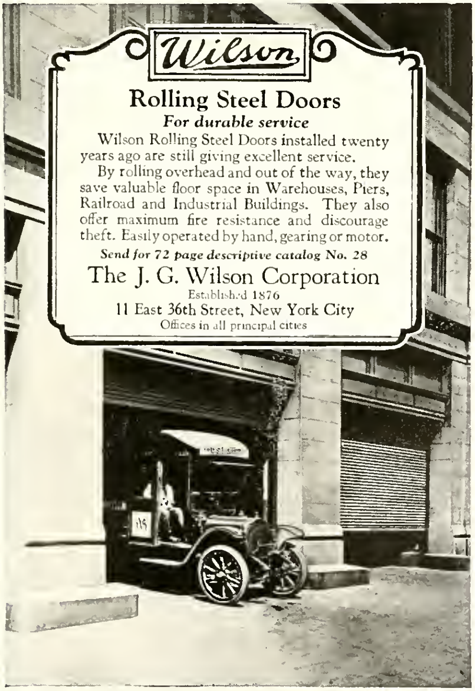

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FRATERNITIES

(Continued from page 149)

TRIANGLE

It is with real pleasure that Triangle is able to announce the purchase of their present home at 3222 South Michigan Boulevard. This comfortable residence has been our rented home for the past year and now becomes our property. We feel that the purchase of our own home in less than three years since our establishment as a local fraternity is a record of which we may well be proud.

There is nothing quite as satisfying as the unhurried enjoyment of a multi-course dinner, well garnished with the chatter of some enthusiastic alumnus about his work. The climax to such a celebration of Founders' day was appropriately carried out by the splendid speakers who so aptly voiced the things we often think. The banquet was given in co-operation with the Chicago Alumni chapter of Triangle at the Chicago Engineers' Club, April 13.

Our spring initiation was held March 7, and was followed by a banquet at the Cooper-Carlton Hotel on the same evening. The presence of many alumni members made the event seem like a sort of home-coming.

The following men help to carry on:

E. C. Bacot, Jr.
C. S. Chandler
G. C. Dufour
H. L. Kreiger
R. K. Langan
F. J. Norman
E. W. Willis

RHO DELTA RHO

A dance is often a quite engaging topic for discussion. Once in a while, however, such an especially fine time is uniformly enjoyed that one wishes to remember it without verbal alterations. Such an occasion was our annual dance held at the Webster Hotel.

At present, preparations are in progress for a farewell party to be given in honor of our graduates-to-be. Those who will be missed are Benjamin, Krivo, and Jacobson.

DELTA TAU DELTA

The stability of an organization is well established by its reaction to new and unusual circumstances. In the face of a "homeless" condition eight good men were admitted to membership in Gamma Beta chapter of Delta Tau Delta. They were:

H. Berg
R. W. Cumming
A. J. Danziger
F. E. Davis
P. A. Graf
C. A. Gustafson
A. T. Nullot
G. L. Tucker

The boys were put through their preliminary paces on the evenings of Friday and Saturday, March 20 and 21. The formal ceremony was performed Sunday afternoon, March 22.

The chapter is looking forward with eager anticipation to the permanent home of the near future.

SIGMA ALPHA MU

With the advent of spring, Sigma Epsilon chapter is formulating plans for a May dance to be held at the Buena Shore Club and a get-together smoker in co-operation with its Alumni Club in Chicago.

The most significant among our social activities of the past few months was an initiation and banquet on March 20 at the Great Northern Hotel. The unique entertainment provided by the pledges and the large attendance of fraters from many of the central states made it one of the most successful of our social endeavors. Sigma Epsilon announces the initiation of the following men into its fold:

M. Abrahamson
J. Goldman
C. Polacek

BETA PSI

During the past month Beta chapter of Beta Psi National Fraternity entertained the alumni of the chapter at two smokers. The entertainment was furnished by members of the active chapter and pledges. Price and Janak wrestled to a draw, thereby putting an exciting climax to the evening. Goetz furnished a few much appreciated musical selections.

Friday evening, March 13, the entire chapter went to Cohan's Grand Theater to see "The Show Off." After the play a discussion took place as to which part was best played. The discussion ended in Harding's Grill, thus marking the end of a successful evening.